Discussion Papers In Economics And Business

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Can the health insurance reforms stop an increase in medical expenditures for middle- and old-aged persons in Japan?*

December 5, 2011

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Abstract: Using two-period panel data from the Nippon Life Insurance Research Institute, this paper tests the hypothesis that an increase in the self-pay ratio of medical expenditures associated with the Japanese health insurance reforms of April 2003 reduced household medical expenditures. We find that the increase in the self-pay ratio had a positive but insignificant effect on the share of medical expenses in household expenditure. However, when we employ the data as repeated cross-sectional observations to increase the sample size, the increase in the self-pay ratio has a significantly positive effect on the share of medical expenditures. This provides corroborating evidence that middle- and old-aged persons were unable to reduce their demand for medical services with the increase in the self-pay ratio. An additional finding is that medical services are a necessary good, particularly for those aged 61 years or older and those with medical expenditures accounting for a relatively high share of medical expenditures in high household expenditure.

Keywords Health insurance, Medical expenditures, Engle curve, Middle- and old-aged persons, Japan
JEL Classification I11, I18

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* The authors are grateful of Mitsuya Ichien, Mari Kan, Shigeki Kano, Koichiro Matsushita, Shinpei Sano, Koichiro Sawano, Takashi Unayama and the participants in the 2010 Japanese Economic Association Meeting (Spring), Kobe University and Osaka Prefecture University. This research is partially supported by the Japanese Society for the Promotion of Science, Grand-in-Aid, No. 20530196. The views expressed are those of the authors, and do not represent those of the NLI Research Institute.

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Introduction

It is well known that Japan is one of the world's fastest aging societies and the medical expenses associated with this process are rapidly increasing. According to the 2010 White Paper on the Aging Society, early-stage elderly people (persons aged 65–74 years) accounted for 17.3% of the Japanese population in 2000 and this had increased to 20.1% in 2005 and further to 23.1% in 2010.[1] Concomitantly, the ratio of medical costs to GDP was 7.1% in 1998 rising to 8.1% in 2006.[2] Preventing further escalation in medical costs, particularly for older persons requiring additional medical care, is a necessary and pressing policy challenge. The alternatives are the financial collapse of the current medical insurance system or the unprecedented burden of medical costs placed on the next generation, who will have to pay through increases in direct and/or indirect taxation. In response to this urgent policy concern, this paper estimates Engle curves for medical services in Japan and addresses the containment effects of the health insurance reforms that took effect in April 2003 on household medical demand and expenditures, particularly for middle- and old-aged persons as they generally require and spend more on additional medical care. We also consider heterogeneity in the effects of these reforms across different groups by medical expenditure and additionally consider whether medical services are a luxury or a necessary good from estimating Engle curves.

There are two types of universal health insurance schemes in Japan: an employees' health insurance program and a national health insurance program. Regular employees are usually eligible to join an employees' health insurance program (the program also covers their dependents), while others, including nonregular employees, the self-employed, the nonemployed, and the retired, have little choice but to join the national health insurance program. In 2003, the Health Insurance Act was revised in such a way that the self-pay ratio of medical expenditures for regular employees joining an employees' health insurance program was increased, while the ratio for those joining the national health insurance program was unchanged (see Figure 1). To be more specific, the self-pay ratio of medical expenditures for both inpatient and outpatient treatment incurred by employees was raised from 20% to 30%. Members' dependents incurred the increase

[1] The data are from the Japanese Cabinet Office: http://www8.cao.go.jp/kourei/whitepaper/index-w.html

[2] OECD Health Data, 2002 and 2009.

only for inpatient treatment, as the rate for outpatient treatment was already at 30%. For those joining the national health insurance program, the self-pay ratio of medical expenditures for both forms of treatment was unchanged and remained at 30%.

Many studies in the literature have addressed price effects in the demand for medical services. As early as 1971, the RAND Corporation and the US Department of Health and Human Services commenced a joint project (the RAND Health Insurance Experiment) that designed and administered natural and randomized experiments in this area in the US. This project artificially produced exogenous variations in health-related policy by randomizing samples, thereby allowing health economists to examine the policy effects on the demand for medical services. These experiments suggested that the effect of the provision of health insurance on health-related spending was minor (Manning et al. 1987; Newhouse et al. 1993).[3] Whereas the RAND Health Insurance Experiment focused on partial-equilibrium analysis, Finkelstein (2007) estimated the general equilibrium effect of the introduction of Medicare on health spending for the elderly, suggesting that its impact was much larger than that obtained from the RAND experiment.[4] A number of other studies also support the positive impact of Medicare eligibility on the use of health services (Card et al. 2008; Decker 2005;[5] Lichtenberg 2002).

Importantly, despite the lack of suitable data, health economists in Japan have also undertaken research into effective policies designed to reduce medical expenditures. For instance, Yoshida and Takagi (2002) estimated the demand for medical services following the 1997 increase in the self-pay ratio of medical expenditures from 10% to 20% for household heads joining the employees' health insurance program. Yoshida and Takagi (2002) concluded that these reforms had no effect on the demand for medical services. However, one limitation of their work was that the data were from only a single

[3] Zweifel and Manning (2000) and Cutler and Zeckhauser (2000) comprehensively summarized a number of these experiments.

[4] Finkelstein and McKnight (2008) estimated that the introduction of Medicare induced the elderly to cut copayments for health services by 40% in the top quartile of the copayment distribution, and therefore that this had no impact on elderly mortality.

[5] Decker (2005) focused on the effect of Medicare on the demand for health services for treating breast cancer in women before and after 65 years of age.

company, implying that the sample was not random. To address this shortcoming, Kan and Suzuki (2006) obtained data on 11 insurance associations from the Japanese Ministry of Health, Labour, and Welfare and reestimated the effect of the 1997 health insurance reforms on the demand for medical services. In addition, they examined the policy effects on outpatient and inpatient treatment separately.

In contrast to Yoshida and Takagi (2002), Kan and Suzuki (2006) found the price elasticity of demand for outpatient treatment was significantly negative in a range between –0.05 and –0.06. On this basis, the price elasticity for outpatient treatment exceeded elasticities estimated by Bhattacharya et al. (1996), also using Japanese data. However, the price elasticity of demand for inpatient treatment was insignificant. Later, Yoshida and Ito (2000) calculated the demand for outpatient treatment from the number of practice receipts and again considered the effect of the 1997 health insurance reforms. They found that a rise in the self-pay ratio of medical expenditures did not affect demand for household heads but did for their dependents. In these circumstances, the increased burden of medical bills would fall on dependents rather than on household heads.

Sawano (2000) estimated Engle curves for medical services to investigate the impact of the self-pay system on the demand for outpatient treatment for the elderly. Sawano (2000) concluded that medical services were a necessary good and also that a change in the price of elderly care did not affect the demand for elderly care. Yoshida and Kawamura (2009) also examined the elderly care system in a study of physician demand for outpatient treatments. Their finding was that dependents more often visited a physician because the copayment decreased for dependents under the elderly care system, while it remained almost the same for household heads.

The first contribution of this paper is to examine the impact of the 2003 health insurance reforms on medical demand. The second is to focus attention on the demand for medical care among middle- and old-aged persons, as they usually require more medical care than other age groups and now make up a growing share of the Japanese population. We employ a two-period panel dataset on the consumption behavior of the middle-aged and older population conducted by the Nippon Life Insurance (NLI) Research Institute. The survey was administered first in December 2001 and again in December 2003, and thus spans the implementation date (April 2003) of the revised Health Insurance Act.

The main findings are as follows. To start with, we find that the increase in the

self-pay ratio of medical expenditures had a positive but insignificant effect on the share of medical expenses in household expenditure. One possible reason for this result is that the standard error of the policy parameter is sufficiently large for small samples, thereby reducing the significance of the policy parameter. As an alternative approach, we then employ the data not as a balanced panel, but rather as repeated cross-sectional observations to increase the size of the sample. Here, we indeed find that the increase in the self-pay ratio of medical expenditures had a significantly positive effect on the share of medical expenditures, implying that the increase in copayments a patient has to pay exceeds the decrease in medical expenditures through a decrease in the quantity demanded for medical services. This supports the view that middle- and old-aged persons were unable to reduce their demand for medical services with an increase in the self-pay ratio. In addition, we find that medical services are a necessary good, particularly for those aged 61 years or older and those with a relatively high share of medical expenditures in household expenditure.

The remainder of the paper is organized as follows. We begin by providing the conceptual framework. In the subsequent sections, we detail the data and empirical specifications, followed by the estimated results. The final section provides some concluding remarks.

Conceptual framework

This section develops a simple demand model to examine the effects of an increase in the self-pay ratio of medical expenditures on the demand for medical services. We employ the same methodology as Sawano (2000). Let p and $D(p)$ respectively denote the price and demand for a medical service. An individual household pays $\tau pD(\tau p)$ for the medical service, where τ represents the average household self-pay ratio of medical expenditure. An increase in τ then increases but simultaneously decreases the household expenditure of the medical service because of its decrease in the quantity demanded. Which particular effect dominates depends on the price elasticity of the demand curve. Taking the differential of $\tau pD(\tau p)$ with respect to τ yields:

$$\frac{\partial(\tau pD(\tau p))}{\partial \tau} = pD(\tau p)\left[1 + \tau p \frac{D'(\tau p)}{D(\tau p)}\right].$$

The last term indicates the price elasticity of medical service demand. If the demand curve is elastic, an increase in τ decreases the household expenditure for this medical service. On the other hand, if the demand curve is inelastic, household medical expenditure increases. If the elasticity equals one, these opposing effects cancel each other out, and the household medical expenditure remains unchanged, despite the increase in the self-pay ratio of medical expenditures. Therefore, it is unclear whether an individual household bears relatively more of the burden of medical bills with the increase in the self-pay ratio of medical expenditures (for both employees and their dependents) from 20% to 30%.

How does the increase in the self-pay ratio of medical expenditures affect the total medical expenditure $pD(\tau p)$, that is, the sum of out-of-pocket expenditures ($\tau pD(\tau p)$) and health care benefits ($(1-\tau)pD(\tau p)$) incurred by the government? Without doubt, an increase in τ decreases the total medical expenditure if the price remains constant, and so how much the total medical expenditure decreases depends ultimately on the price elasticity of demand for medical services. If the demand curve is elastic, the total medical expenditure substantially decreases; in contrast, if the demand curve is inelastic, the amount of any decrease is small.

We estimate Engle curves for medical services to test the effect of an increase in the self-pay ratio of medical expenditures on the demand for medical services. Because our two-period panel data straddle the implementation date of the Health Insurance Act, we can employ a difference-in-difference (DID) method, allowing for comparison of a treatment group and a control group. Households that have at least one employee who faces an increase in the self-pay ratio of medical expenditures belong to the treatment group, while households in which a middle- or old-aged man and his spouse are either self-employed, nonemployed, or retired belong to the control group. Following Leser (1963), Deaton and Muellbauer (1980), and Sawano (2000), the econometric specification of the Engle curve follows a first-difference structure:

$$\Delta MS_i = \beta_0 + \beta_1 \Delta X_i + \beta_2 \Delta D_i + \beta_3 \Delta T_i D_i + \beta_4 \Delta \log(E_i) + \Delta u_i,$$

where MS_i is the ratio of household medical expenditures to total household expenditure,

E_i is total expenditure per household member, T_i is a year dummy, D_i is a dummy indicating to which group the individual belongs (i.e. the treatment or control group), and T_iD_i is the cross term of T_i and D_i. ΔT_iD_i indicates a policy variable and equal one if and only if a household has at least one employee joining an employees' insurance program after the implementation date of the 2003 Health Insurance Act, irrespective of her or his insurance status before the date. Finally, X_i represents a vector of individual characteristics.

We should note that not all households belong to the same group during both periods; that is, some employed individuals as of December 2001 had become self-employed or retired by December 2003, and vice versa. The coefficient β_2 therefore captures the effect of changes in employment status of household members on household medical expenditures. The coefficient β_3 is the one for the cross term indicating the policy effect of the increase in the self-pay ratio of medical expenditures on *MS*. Because we assume total household expenditure (the denominator of *MS*) is exogenous according to the static model of preference maximization, β_3 also implies the effect of the increase in the self-pay ratio of medical expenditures on the household expenditure for medical services (the numerator of *MS* or $\tau pD(\tau p)$).[6] This policy measure allows us to distinguish the effect of the policy change from any other factors (such as macroeconomic shocks) that commonly affect every household. Finally, β_4 indicates whether medical services are a luxury or a necessary good. If the estimated coefficient β_4 is positive, we can consider medical services a luxury good, but if β_4 is negative, medical services are a necessary good.

There are two points to keep in mind when we use the DID method. First, it is possible that the policy change is endogenous, in the sense that many employees and their dependents faced with the increase in the self-pay ratio of medical expenditures were encouraged to visit a hospital, even for nonemergency care, before the revised Health

[6] For simplicity, the problem of preference maximization is given by: max $u(z_1, z_2)$ subject to $\tau pz_1+z_2=I$, where z_1 is the demand for (consumption of) medical services, z_2 is the bundle of other consumption goods with the price normalized to one, and I is exogenous total household expenditure. Therefore, the demand for medical services is derived implicitly by $z_1=D(\tau p, I)$. We assume that both τ and I are exogenous and independent of each other. For simplicity, I is omitted from the demand function for medical services.

Insurance Act took effect. This problem is not so serious because the survey was conducted in December 2001, long before the implementation date of the Health Insurance Act, even before this act was approved in the Diet in July 2002. We assume that as of December 2001, people did not anticipate this legislative change. Second, we must assume that both the treatment and the control groups are homogeneous with respect to any unobservable factors. Otherwise, it is difficult to determine whether any difference in medical service demand between the two groups is attributable to the changing legislation or to the heterogeneity of the groups with respect to the other factors. To partly control for this, various household characteristics are included in the estimations.

As we later explain, because we reconstitute balanced panel data to estimate first-difference equations, the sample size unfortunately becomes very small. The first-difference estimator is then less precise. To address this shortcoming, we would prefer to treat the data as repeated cross-sectional observations instead of balanced panel data in estimating the DID structure. This allows us to include unbalanced observations and therefore increase the sample size. However, we should be aware of a shortcoming in using repeated cross-section data. In sum, if the composition of the treatment and control groups is systematically different before and after the implementation of the reforms, the policy parameter is potentially biased. This is because any difference in the demand for medical services between the groups then results not only from the legislative change, but also from exogenous differences between the two groups with respect to unobserved factors.

In addition, we consider the heterogeneous effects of the revised Health Insurance Act on the demand for medical services across different groups by medical expenditure using quantile regression methods. We expect that the adverse effect of this change is greater for those who spend relatively more of their household expenditure on medical services. Note again that we do not treat the data as a panel in estimating the quantile regression, but rather as repeated cross-sectional observations. This is beneficial for obtaining the sufficiently large size of samples, although there is the possibility that the treatment assignment is not random.

Data

The data used in this study are a Japanese micro-level dataset, the Survey for Living and Life Design (*kurashi to seikatusekkei nikannsuru chousa*) conducted by the NLI Research Institute.[7] This survey was designed to reveal how middle- and old-aged persons (whose share of the population in Japan is rapidly growing) transition through life. This survey was conducted in December every second year from 1997 to 2003, and samples men born between 1933 and 1947 as per the area sampling method. In 1997, therefore, the respondents were aged between 50 and 64 years. The survey included 1,502 respondents in 1997, 1,034 in 1999, 910 in 2001, and 814 in 2003. As the purpose of the current study is to address whether the Health Insurance Act that took effect in April 2003 is effective in constraining medical expenses, we use the third (2001) and fourth (2003) surveys.

We now explain our means of differentiating between the treatment and the control groups. To do this, it is necessary to identify the employment status of each individual respondent (men) and his spouse (women) because the increase in the self-pay ratio of medical expenditures applies only to those joining an employees' health insurance program, as determined by employment status. Five types of employment status are possible for each individual respondent:

(i) regular employees—those who self-reported that they worked as a regular employee;

(ii) nonregular employees (1)—those who self-reported that they worked as a nonregular worker, and responded that they worked three-quarters of a regular employee's weekly hours of work (30 hours a week) or more;[8]

(iii) nonregular employees (2)—those who self-reported that they worked as a nonregular worker, responded that they worked less than three-quarters of a regular employee's weekly hours of work (30 hours a week), and earned an annual income of JPY1.3 million or more if aged less than 60 years, or JPY1.8 million or more if aged 60 years or older;

[7] A member of the Nippon Life Insurance Company (NISSAY) group.

[8] When data on the weekly hours of work are missing, but those for the daily hours of work and monthly working days are available, we calculate the average weekly hours of work as the monthly working days divided by 4.3 times the daily hours of work.

(iv) nonregular employees (3)—those who self-reported that they worked as a nonregular worker, responded that they worked less than three-quarters of a regular employee's weekly hours of work (30 hours a week), and earned an annual income of less than JPY1.3 million if aged less than 60 years, or less than JPY1.8 million if aged 60 years or older;

(v) self-employed—those who self-reported that they worked as a self-employed worker, including professionals;

(vi) nonemployed—those who did not report that they worked, including the retired.

We consider nonregular employees (1) as substantially regular employees, the difference being that while regular employees are eligible to receive generous welfare benefits in compensation for compliance of instruction in the course of employment, nonregular employees usually do not participate in a welfare program but can flexibly arrange workplace conditions and working hours. We should be aware that a nonregular employee (2) earns too much income to be a dependent of his spouse, even if she is a regular employee, and thus has to participate individually in the national health insurance program. In contrast, a nonregular employee (3) is still eligible to be a dependent of his spouse if she is a regular employee.

Because the dataset does not include comparable information on the employment status of spouses (all female), we obtain this using their annual salary or income. Annual income includes salary, pension benefits (public and private), and dividends. We assume that a spouse is a regular employee signing up to her own employees' health insurance program if her annual salary is over JPY2.74 million if she is aged 40–44 years, JPY2.81 million if aged 45–49 years, JPY2.90 million if aged 50–54 years, JPY2.89 million if aged 55–59 years, JPY2.33 million if aged 60–64 years, and JPY2.23 million if she is 65 years or older. These figures represent the average annual salary for middle school graduates for each age range.[9] We employ them as lax threshold points to distinguish between regular and nonregular employees. Alternatively, we consider a spouse who earns an annual salary of less than the corresponding annual salary

[9] The data are from the 2002 Japanese Wage Census conducted by the Japanese Ministry of Health, Labor, and Welfare: http://www.mhlw.go.jp/toukei/itiran/roudou/chingin/kouzou/z02/index.html.

as a nonregular employee in the national health insurance program. However, if a spouse's annual income, inclusive of salary, pension benefits, and dividends, is less than JPY1.3 million (less than JPY1.8 million for those aged 60 years or older), and if her husband is a regular employee, she is eligible to be her husband's dependent, and so is partially covered by his employees' health insurance program. In this case, the spouse's self-pay ratio of medical expenditures was 20% for inpatient treatment prior to the health insurance reforms. The drawback of this approach is that we cannot identify whether a spouse earning her own salary is employed or self-employed.

Table 1 displays the cross-sectional matrix of the types of health insurance for each individual (male) respondent and his spouse (female). There are four groups based on the combination of insurance programs. Group 1 consists of households where both the respondent and his spouse are regular employees (or regular employees of substance), in which case both have incurred the increase in the self-pay ratio of medical expenditures for outpatient and inpatient treatment from 20% to 30%. Group 2 includes regular employees whose spouse is either nonemployed, a nonregular employee, or self-employed (an employer) with an annual income of less than JPY1.3 million (or less than JPY1.8 million for spouses aged 60 years or older). They then benefit from coverage of the employees' health insurance program of which their partner is a member. Although the revision of the Health Insurance Act increased the self-pay ratio of medical expenditures for regular employees from 20% to 30% for both outpatient and inpatient treatment, it increased the self-pay ratio for their spouses from 20% to 30% only for inpatient treatment; the self-pay ratio for outpatient treatment remained at 30%.

Group 3 includes regular employees whose spouse is either self-employed or a nonregular employee with an annual income of JPY1.3 million or more (or JPY1.8 million or more for spouses aged 60 years or older). Neither this type of nonregular employee nor the employer is eligible to benefit from coverage of the employees' health insurance program of which their partner is a member, and so they participate in the national health insurance program. Although the regular employee incurred increases in the burden of medical expenditures for inpatient and outpatient treatment, the burden for the spouse remained unchanged (at 30% for both treatments). Finally, Group 4 consists of households where both the respondent and his spouse are nonemployed, self-employed, or nonregular employees. Because both are in the national health insurance program, the

health insurance reforms had no adverse impact on their burden of medical expenditures. We contend that the revision of the Health Insurance Act increased the burden of medical expenditure to the greatest extent in Group 1, followed by Groups 2 and 3, and did not affect the burden of medical expenditure for Group 4.

We consider three cases to distinguish between the treatment and control groups: <Treatment A>, Groups 1 and 2 as the treatment group and Groups 3 and 4 as the control group; <Treatment B>, Groups 1 to 3 as the treatment group and Group 4 as the control group; and <Treatment C>, individual respondents (men) who joined an employees' health insurance program and those signing up for national health insurance.[10] The first two treatments take account of the employment status of (female) spouses in grouping the treatment and control groups, while the last treatment omits the employment status of (female) spouses and defines the two groups only by the (male) individual's insurance program (that is, employment status).

We remove households from our sample where a respondent is aged 70 years or older because their medical expenditures are determined under a different medical system for the elderly. In principle, the self-pay ratio of medical expenditures for those aged 70 years or older remains at 10%, regardless of employment status. For example, a regular employee aged 68 years in 2001 became 70 years of age in 2003 and so automatically has a lower burden of medical expenditures in 2003 (10% according to Figure 1).

We specify the ratio of household medical expenses to total household expenditure as the dependent variable. Using this variable, we remove outliers from the sample: we define outliers as values of the dependent variable greater than one or more than three standard deviations from the mean. The ratio is then regressed on the logarithm of total household expenditure per household member to estimate the Engle curve. In addition, we include individual characteristics, particularly health condition, in the vector of explanatory variables. For instance, the survey subjectively asked the sampled men whether they were healthy, whether their spouse was still living, and if so, whether she was healthy. We also include the number of family members and a dummy variable indicating whether a respondent was working.

[10] We do not consider the option of distinguishing between Group 1 and the remaining groups, as Group 1 includes few households.

Because our purpose is to compare medical expenditures before and after the date of implementation of the health reforms, we first remove any cross sectional observations with data missing in 2001 or 2003 to obtain a balanced panel. The sample size is then 81 households per year when the employment status of spouses is included in grouping the treatment and control groups (that is, <Treatment A> and <Treatment B>). However, the sample size substantially increases to 215 per year when the employment status of spouses does not categorize the two groups (that is, <Treatment C>).[11] Table 2 provides some summary statistics. As shown, the share of medical expenditures in total household expenditure decreased from 2001 to 2003 in <Treatment A> and <Treatment B>. However, the difference is minimal in <Treatment C>.

Table 3 details the distribution of employment status each year. In <Treatment A> and <Treatment B>, where the employment status of spouses is taken into account in grouping, the proportion of those who were nonemployed increased from 25.93% to 27.16% over the period. In contrast, the proportion of regular employees decreased from 14.81% to 13.58% over the same period. Nonregular employees (1), here considered as substantially regular employees, accounted for 28.40% of the sample in 2001, and this decreased markedly to 20.99% in 2003. More than one-quarter of the sampled men were self-employed in 2001, while about one-third were self-employed in 2003. As one would expect, the proportion of employees decreased over the sample period, while the proportion of nonemployed increased. Similarly, spouses engaging in nonregular work were more likely to reduce their working hours or to be nonemployed during both periods. When we ignore the employment status of spouses in grouping (<Treatment C>), the proportions of regular and nonregular employees (1) decreased, while that of nonemployed increased. We then again confirm that older men were less likely to work.

Table 4 displays a transition matrix of employment status from 2001 to 2003. In <Treatment A> and <Treatment B>, the majority of men maintained their employment status in 2001 and 2003. For example, 75% of regular employees remained regularly employed and only 8.33% became nonemployed, while 65.22% of nonregular employees (1) maintained their employment status from 2001 to 2003 and only 4.35% became

[11] The sample size is smaller in <Treatment A> and <Treatment B> because many observations are missing for the annual income of employed spouses (female) used for grouping by employment status.

nonemployed. However, we can also see that employees gradually reduced their work burden from regular employment to nonregular employment or retirement (or nonemployment). In a similar manner, spouses engaging in regular work also reduced their working hours or retired as they became older while some nonregular spouses increased their work burden. We observe similar results with <Treatment C>.

Table 5 provides the transition matrices of those incurring an increase in the self-pay ratio of medical expenditures across the three treatments. As shown in <Treatment A>, 71.60% of households are not subject to the increase in the self-pay ratio from 20% to 30%. As most are middle- or old-aged, they are less likely to have regular employment, and are therefore exempt from the health insurance reforms. When we group individual men according to <Treatment B>, 54.32% of households did not incur any additional burden from the increase in the self-pay ratio of medical expenditures. In <Treatment C>, 38.60% of men joined an employees' insurance program in 2003 and therefore had to pay the additional payments of medical services after the health reforms took effect.

Results

Table 6 presents the estimates of the Engle curve for the policy effect on medical expenditures from estimating the first-difference model with the balanced panel data. Columns [1] and [4] provide the results when samples are grouped according to <Treatment A>; columns [2] and [5] provide the results for <Treatment B>, and columns [3] and [6] for <Treatment C>. The key outcome is that the coefficient on the policy parameter (insurance type × year) is positive but statistically insignificant in all columns, implying that the increase in the self-pay ratio of medical expenditures increased the share of household expenditure spent on medical services, but that this is not statistically supported. Recall that while the increase in the self-pay ratio of medical expenditures increased the price of medical services, it simultaneously lowered the quantity demanded of medical services. Our estimated results suggest that the former effect was dominant over the latter one, but it should be aware that the net effect is statistically insignificant. In addition, this provides corroborating evidence that if anything, the increase in the self-pay ratio of medical expenditures would mildly decrease total medical expenditures (that is,

the sum of the expenditure incurred by an individual household and the health care benefits incurred by the Japanese government).

One possible reason why this policy effect is statistically insignificant is that the survey date of 2003 was so close to the implementation of the reforms that the effect of the reforms had not yet been felt. It is then necessary to attempt to capture the lasting effect of the reforms. Another possible reason is that the sample size is relatively small in the balanced panel data, which leads to a large standard error for the policy parameter, and thereby lowers the significance of the policy parameter. We should keep in mind that the increase in the self-pay ratio of medical expenditures had the potential to increase the share of household expenditure spent on medical services, although its effect was statistically insignificant in our estimations when using small samples.

Considering the other factors determining the share of medical expenditures, the coefficient for total expenditure per household member is negative at the 1% level of significance in all columns. This confirms, as in Sawano (2000), that medical services are a necessary good. The number of family members has a negative effect on medical expenditures at the 5% level of significance in columns [4] to [6]. The share of medical expenditures lowers with the number of family members, holding the total expenditure per household member fixed. These results show the way of allocating a family budget to medical services and other goods and services as the number of family members increases, given that the total expenditure per household member is fixed. This could be because while an individual man and his spouse are usually both middle- or old-aged, we expect that other family members are younger and healthier, and so would rather direct expenditure to consumption than to health care. As family size increases, therefore, the share of medical expenditures in total household expenditure declines.[12] Finally, own-health negatively affects the ratio of medical expenditures at the 5% level of

[12] Note that the coefficient on the number of family members captures the partial effect of an increase in the self-pay ratio of medical expenditures on the share of medical expenditures in household expenditure, holding the total expenditure per household member fixed. The complete effect can be obtained if we regress the share of medical expenditures on family size and the logarithm of total household expenditure. The complete effect would be expected positive; if one more member joins in a family while the total household expenditure is fixed, the share of medical expenditures in household expenditure is expected to increase because the new member also spends the money for medical services.

significance according to column [6]; contrary to our predictions, however, the own-health of the spouse increases the share of medical expenditures, but only at the 10% level of significance in column [4].

To obtain more precise estimators, we employ an alternative approach using the data as repeated cross-sectional observations. Because the data include unbalanced observations, this allows us to increase the sample size. Table 7 presents the estimated results. In contrast to the results shown in Table 6, the coefficient on the policy variable turns out to be positive at the 5–10% level of significance in columns [2], [3], [5], and [6]. In effect, the increase in the self-pay ratio of medical expenditures has increased the share of household expenditure spent on medical services. This implies that the price elasticity of demand for medical services was less than one in absolute terms; that is, the quantity demanded of medical services did not decrease sufficiently to counter the increased burden of medical expenditures caused by the increase in the self-pay ratio of medical expenditures.

We should take care when interpreting these results. As mentioned earlier, if the composition of the treatment and control groups systematically changed after the legislative change, the policy parameter is potentially biased because any difference in the demand for medical services between the two groups could be attributable to unobservable differences between the two groups with respect to individual characteristics as well as to the legislative change.

Table 8 provides the first-difference estimators for the subsample of respondents aged 61 years or older in 2001. We anticipate two opposing effects of an increase in the self-pay ratio of medical expenditures. The first is that that the increase in the self-pay ratio of medical expenditures seriously increases the burden of medical expenditures for those aged 61 years or older because they typically require more medical care. The second is that the health insurance reforms do not affect household medical expenditures for those aged 61 years or older as they have already retired because many Japanese companies implement an age-based retirement system and set the retirement age at 60 years.

The results are similar to those in Table 6. That is, the health insurance reforms positively but insignificantly affected the burden of household expenditures for medical services for men aged 61 years or older. However, the coefficient on the policy variable is

smaller in magnitude in Table 8 than in Table 6. This suggests that the health insurance reforms had only a minor effect on medical expenditures for those aged 61 years or older. These results instead support the second hypothesis that the increase in the self-pay ratio of medical expenditures did not affect the burden of medical expenses for those aged 61 years or older. To obtain more precise estimators, Table 9 shows the estimated results using the repeated cross-section data that include any unbalanced observations. The coefficient on the policy variable turns out to be positive but only at the 10% level of significance in columns [3] and [6] for <Treatment C>. This implies that the increase in the self-pay ratio of medical expenditures increased the share of household expenses spent on medical services, although the impact was only statistically marginal.

In both Tables 8 and 9, the coefficient on total expenditure per household member is still negative, again implying that medical services are a necessary good. We also find that the coefficient is larger in magnitude for those aged 61 years or older than for the unrestricted sample shown in Tables 6 and 7. Consequently, medical services are more strongly a necessary good for those aged 61 years or older.

To see whether the effect of the legislative change on medical expenditures vary by the budget share of medical expenditures, Table 10 presents the estimates of quantile regressions for the five quantile values {0.1, 0.25, 0.5, 0.75, 0.9}. Column [1] shows the result when samples are grouped according to <Treatment A>, followed by column [2] for <Treatment B>, and column [3] for <Treatment C>. In columns [1] to [3], the coefficient on the policy variable (insurance type × year) remains insignificant for all of the quantile values.

In column [1], while the sign of the coefficients on the policy variable is negative for the lower quantile value, their sign turns out to be positive for the higher quantile values. While an increase in the self-pay ratio of medical expenditures increased the price of medical services, it simultaneously decreased the quantity demanded, thereby lowering the household expenditure of medical services. For higher quantile values, the former effect dominates the latter, although the net effect is statistically insignificant. This implies that this particular health insurance reforms did not cut demand for medical services more sharply for households with a higher burden of medical expenditures in total household expenditure. The sign of the coefficient on the policy variable remains positive, regardless of the quantile value in column [2]. The observed policy impact on

the demand for medical services then substantially varies according to the criteria used to define the treatment and control groups.

The coefficient on total expenditure per household member remains significantly negative for any quantile value, regardless of the type of treatment. This is consistent with the estimates in Tables 6 and 7. The magnitude of the estimated coefficient also increases almost systematically with the quantile value. This again implies that medical services are more strongly a necessary good for households with a higher share of medical expenditures in total household expenditure.

The coefficients for the number of family members, own-health, and spouse's own-health are significantly negative for many quantile values in all columns. As discussed, family members other than the sample man and his spouse are usually younger and healthier, so the increase in the family size would encourage the family to allocate its budget to other goods and services rather than medical services, which lowers the ratio of medical expenditures to household expenditure. Needless to say, a healthy man and his spouse do not spend much on medical services. The coefficient for work is significantly positive for many quantile values. That is, if a middle- or old-aged man works too much, he requires more medical care to maintain his health condition.

Table 11 presents the estimates of the quantile regressions when the sample data are limited to male household heads aged 61 years or older. As shown, the coefficient on the policy variable is insignificant for any quantile value. The coefficient on total expenditure per household remains significantly negative for each quantile value in all columns. This confirms again that medical services are a necessary good for men aged 61 years or older.

Concluding remarks

Using a panel of two-period data gathered by the NLI Research Institute, this paper explored the hypothesis that the increase in the self-pay ratio of medical expenditures associated with health insurance reforms taking effect in Japan in April 2003 cut household medical expenditure. We focused our attention on the consumption of medical services for middle- and old-aged persons, whose share of the Japanese population has been rapidly growing in recent years. We estimated Engle curves for medical services and

employed the difference-in-difference method, dividing our sample into a treatment group whose self-pay ratio of medical expenditures increased from 20% to 30%, and a control group whose self-pay ratio remained unchanged. In addition, we estimated quantile regressions to consider any heterogeneity in the effect of this legislative change across different groups by medical expenditure.

Our main finding using the balanced panel data is that the increase in the self-pay ratio had a positive but insignificant effect on household medical expenses. This result implies that a decrease in the quantity demanded of medical services through the price rise is not enough to offset the increase in the medical expenditures incurred by a household through the price rise, although this net effect is statistically insignificant. If anything, the price elasticity of demand for medical services by middle- and old-aged persons was rather inelastic. We obtained similar results when limiting our sample data to persons aged 61 years or older.

Our plans for this line of research involve capturing the long-term effect, if any, of the 2003 health insurance reforms. One possible reason why we found a somewhat insignificant effect of the reforms is that the survey date in 2003 was so close to the date of implementation. Accordingly, the reforms may not yet have had time to be effective. Capturing any lasting effect of the reforms is then a crucial task.

Another possible reason is the small sample size; that is, because the sample size is relatively small, we obtain a large standard error of the policy parameter, thus reducing the significance of the policy parameter. To address this shortcoming, we estimated the policy effect using the data as repeated cross-sectional observations. This allowed us to include unbalanced observations and thereby increase the sample size. We then found that the increase in the self-pay ratio had a significantly positive effect on the share of household medical expenditures. This result implies that middle- and old-aged persons were unable to cut sufficiently the quantity demanded of medical services in response to the increase in the self-pay ratio of medical expenditures. However, we should be aware that this policy effect could include potential bias if the composition of the treatment and control groups systematically changed following implementation of the reforms.

We also found that per household expenditure had a significantly negative effect on medical expenditures, implying (as expected) that medical services are a necessary good. After confining the sample data to persons aged 61 years or older, this coefficient

became larger in absolute terms. Accordingly, medical services are more strongly a necessary good for those requiring more medical care. We verify these results using the estimates of the quantile regressions, and confirm that the coefficient on household expenditure per household member increases in absolute terms with the quantile value. This suggests that medical services are more strongly a necessary good for individuals from households where medical expenditures account for a larger share of total household expenditure.

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Table 1: Cross-sectional Matrix of Health Insurance Types

Employment status wife husband		over JPY X* million for annual salary (regular employee)	JPY 1.3**（annual income) ～X* million (annual salary) (nonregular employee)	less than JPY 1.3** million (annual inome) (nonregular employee+nonemployed)	bereaved
regular employee	husband	employee's insurance	employee's insurance	employee's insurance	employee's insurace
	wife	employee's insurance	national insurance	employee's insurance (dependent)	
nonregular employee (1)	husband	employee's insurance	employee's insurance	employee's insurance	employee's insurace
	wife	employee's insurance	national insurance	employee's insurance (dependent)	
nonregular employee (2)	husband	national insurance	national insurance	national insurance	national insurance
	wife	employee's insurance	national insurance	national insurance	
nonregular employee (3)	husband	employee's insurance (dependent)	national insurance	national insurance	national insurance
	wife	employee's insurance	national insurance	national insurance	
self-employed	husband	national insurance	national insurance	national insurance	national insurance
	wife	employee's insurance	national insurance	national insurance	
nonemployed	husband	employee's insurance (dependent)	national insurance	national insurance	national insurance
	wife	employee's insurance	national insurance	national insurance	

Group 1 Both incurred increases in the self-pay ratio of medical expenditures for outpatient and hospital treatments from 20% to 30%.

Group 2 the % of medical expenditures for the regular employee was raised from 20% to 30% for both outpatient and hospital treatments, but the % for the spouse (non-regular employee or the non-employee) was raised from 20% to 30% only for hospital treatments.

Group 3 The regular employee incurred increases in the burden of medical expenditures for both hospital and outpatient treatments, while the burden born by the spouse (non-regular employee or the employer) had remained unchanged.

Group 4 The revision of the health insurance act had no adverse impact on the burden of medical expenditures.

Husband

regular employee — those who self-reported that they worked as a regular employee

nonregular employee (1) — those who self-reported that they worked as a non-regular worker, and responded that they worked three quarters of regular employees' weekly hours of work, 30 hours a week or more.

nonregular employee (2) — those who self-reported that they worked as a non-regular worker, responded that they worked less than three quarters of regular employees' weekly hours of work (30 hours a week), and earned an annual income of over JPY 1.3 million if aged under 60 years or over JPY1.8 million if aged over 60 years

nonregular employee (3) — those who self-reported that they worked as a non-regular worker, responded that they worked less than three quarters of regular employees' weekly hours of work (30 hours a week), and earned an annual income of less than JPY 1.3 million if aged under 60 years or less than JPY1.8 million if aged over 60 years

self-employed — those who self-reported that they worked as a self-employed worker, including professionals

nonemployed — those who did not reported that they worked, including the retired

* JPY2.74 million (40 - 44 yrs of age), JPY2.81 million (45 - 49 yrs of age), JPY2.90 million (50 - 54 yrs of age) JPY2.89 million between (55 - 59 yrs of age), JPY2.33 million (60 - 64 yrs of age), and JPY2.23 million (over 65 yrs of age)

** JPY1.8 million for spouses more than 60 years of age

Table 2: Summary Statistics

(1) The employment status of spouses is taken into account in grouping.

<Treatments A & B>

2001 Variable	Obs	Mean	Std. Dev.	Min	Max
medical cost/expenditure	81	0.096	0.106	0.006	0.500
ln(per expenditure)	81	4.349	0.537	3.219	5.695
# of family	81	2.802	1.134	1	7
health (=1)	79	0.810	0.395	0	1
work (=1)	81	0.741	0.441	0	1
spouse (=1)	81	0.926	0.264	0	1
spouse's health (=1)	81	0.778	0.418	0	1
group 1	81	0.062	0.242	0	1
group 2	81	0.235	0.426	0	1
group 3	81	0.198	0.401	0	1
group 4	81	0.506	0.503	0	1

2003 Variable	Obs	Mean	Std. Dev.	Min	Max
medical cost/expenditure	81	0.089	0.095	0.008	0.600
ln(per expenditure)	81	4.329	0.611	2.108	5.520
# of family	81	2.852	1.174	1	7
health (=1)	80	0.788	0.412	0	1
work (=1)	81	0.728	0.448	0	1
spouse (=1)	81	0.926	0.264	0	1
spouse's health (=1)	81	0.753	0.434	0	1
group 1	81	0.025	0.156	0	1
group 2	81	0.259	0.441	0	1
group 3	81	0.173	0.380	0	1
group 4	81	0.543	0.501	0	1

The employment status of spouses is categorized by their annual income or earnings.

(2) The employment status of spouses is not taken into account in grouping

<Treatments C>

2001 Variable	Obs	Mean	Std. Dev.	Min	Max
medical cost/expenditure	215	0.109	0.134	0.005	0.818
ln(per expenditure)	215	4.258	0.672	1.273	5.858
# of family	215	2.991	1.211	1	7
health (=1)	215	0.781	0.414	0	1
work (=1)	215	0.721	0.450	0	1
spouse (=1)	215	0.972	0.165	0	1
spouse's health (=1)	215	0.809	0.394	0	1
employee's insurance (=1)	215	0.447	0.498	0	1

2003 Variable	Obs	Mean	Std. Dev.	Min	Max
medical cost/expenditure	215	0.110	0.126	0.006	0.667
ln(per expenditure)	215	4.292	0.596	2.108	5.520
# of family	215	2.981	1.260	1	7
health (=1)	215	0.772	0.420	0	1
work (=1)	215	0.674	0.470	0	1
spouse (=1)	215	0.967	0.178	0	1
spouse's health (=1)	215	0.800	0.401	0	1
employee's insurance (=1)	215	0.386	0.488	0	1

Table 3: Distribution of Employment Status

(1) The employment status of spouses is taken into account in grouping. <Treatments A & B>

Husband (male)	2001			2003		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
regular employee	12	14.81	14.81	11	13.58	13.58
nonregular employee (1)	23	28.40	43.21	17	20.99	34.57
nonregular employee (2)	1	1.23	44.44	1	1.23	35.80
nonregular employee (3)	1	1.23	45.67	3	3.70	39.50
self-employed	23	28.40	74.07	27	33.33	72.83
nonemployed	21	25.93	100.00	22	27.16	100.00
Total	81	100.00		81	100.00	

Spouse (female)	2001			2003		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
regular employee	9	12.00	12.00	10	13.33	13.33
nonregular employee (over JPY1.3 million)	21	28.00	40.00	19	25.33	38.66
nonregular (less JPY1.3 million)+nonemployed	45	60.00	100.00	46	61.33	100.00
Total	75	100.00		75	100.00	

The employment status of spouses is categorized by their annual income or earnings.

(2) The employment status of spouses is not taken into account in grouping. <Treatment C>

Male	2001			2003		
	Freq.	Percent	Cum.	Percent	Cum.	
regular employee	35	16.28	16.28	26	12.09	12.09
nonregular employee (1)	61	28.37	44.65	57	26.51	38.60
nonregular employee (2)	2	0.93	45.58	1	0.47	39.07
nonregular employee (3)	4	1.86	47.44	8	3.72	42.79
self-employed	53	24.65	72.09	53	24.65	67.44
nonemployed	60	27.91	100.00	70	32.56	100.00
Total	215	100.00		215	100.00	

Table 4: Transitions of Employment Status

(1) The employment status of spouses is taken into account in grouping. <Treatments A & B>

Husband 2003 / 2001	regular	nonregular (1)	nonregular (2)	nonregular (3)	self-employed	nonemployed	Total
regular	9	1	0	1	0	1	12
	75.00	8.33	0.00	8.33	0.00	8.33	100.00
nonregular (1)	2	15	1	1	3	1	23
	8.70	65.22	4.35	4.35	13.04	4.35	100.00
nonregular (2)	0	1	0	0	0	0	1
	0.00	100.00	0.00	0.00	0.00	0.00	100.00
nonregular (3)	0	0	0	1	0	0	1
	0.00	0.00	0.00	100.00	0.00	0.00	100.00
self-employed	0	0	0	0	23	0	23
	0.00	0.00	0.00	0.00	100.00	0.00	100.00
nonemployed	0	0	0	0	1	20	21
	0.00	0.00	0.00	0.00	4.76	95.24	100.00
Total	11	17	1	3	27	22	81
	13.58	20.99	1.23	3.70	33.33	27.16	100.00

Spouse 2003 / 2001	regular	nonregular	nonregular+ nonemployed	Total
regular	7	1		9
	77.78	11.11	11.11	100.00
nonregular (over JPY1.3 million)	0	7	14	21
	0.00	33.33	66.67	100.00
nonregular (less JPY 1.3 million)	3	38	4	45
+ nonemployed	6.67	84.44	8.89	100.00
Total	10	46	19	75
	13.33	61.33	25.33	100.00

The employment status of spouses is categorized by their annual income or earnings.

(2) The employment status of spouses is not taken into account in grouping. <Treatment C>

Male 2003 / 2001	regular	nonregular (1)	nonregular (2)	nonregular (3)	self-employed	nonemployed	Total
regular	25	7	0	1	1	1	35
	71.43	20.00	0.00	2.86	2.86	2.86	100.00
nonregular (1)	0	43	1	4	4	9	61
	0.00	70.49	1.64	6.56	6.56	14.75	100.00
nonregular (2)	0	2	0	0	0	0	2
	0.00	100.00	0.00	0.00	0.00	0.00	100.00
nonregular (3)	0	3	0	1	0	0	4
	0.00	75.00	0.00	25.00	0.00	0.00	100.00
self-employed	0	1	0	1	45	6	53
	0.00	1.89	0.00	1.89	84.91	11.32	100.00
nonemployed	1	1	0	1	3	54	60
	1.67	1.67	0.00	1.67	5.00	90.00	100.00
Total	26	57	1	8	53	70	215
	12.09	26.51	0.47	3.72	24.65	32.56	100.00

Table 5: Transitions of Medical Insurance Programs

<Treatment A>

2003 / 2001	0	1	Total
0	52	5	57
	91.23	8.77	100.00
1	6	18	24
	25.00	75.00	100.00
Total	58	23	81
	71.60	28.40	100.00

group 1 and 2 = 1, group 3 and 4 = 0
We assume that group 1 and 2 are adversely affected by the revision of the health insurance act.

<Treatment B>

2003 / 2001	0	1	Total
0	39	2	41
	95.12	4.88	100.00
1	5	35	40
	12.50	87.50	100.00
Total	44	37	81
	54.32	45.68	100.00

group 1, 2 and 3 = 1, group 4 = 0
We assume that group 1, 2 and 3 are adversely affected by the revision of the health insurance act.

<Treatment C>

2003 / 2001	0	1	Total
0	111	8	119
	93.28	6.72	100.0
1	21	75	96
	21.88	78.13	100.0
Total	132	83	215
	61.40	38.60	100.00

employee's insurance program = 1
national insurance program = 0

Table 6: Estimated Results (First Difference Estimation)

	denpendent value: Δ(medical cost/expenditure)					
independent	A	B	C	A	B	C
variables	[1]	[2]	[3]	[4]	[5]	[6]
Δln(per expenditure)	-0.114 ***	-0.119 ***	-0.127 ***	-0.130 ***	-0.134 ***	-0.138 ***
	(0.030)	(0.031)	(0.020)	(0.033)	(0.032)	(0.019)
Δinsurance status	-0.033	-0.019	0.016	-0.009	-0.001	0.035
	(0.030)	(0.025)	(0.020)	(0.029)	(0.025)	(0.021)
Δinsurance status×year	0.045	0.039	0.012	0.037	0.033	0.007
	(0.031)	(0.024)	(0.020)	(0.034)	(0.023)	(0.019)
Δ# of family				-0.040 **	-0.041 **	-0.027 **
				(0.019)	(0.018)	(0.014)
Δown health				-0.026	-0.027	-0.053 **
				(0.040)	(0.039)	(0.027)
Δ work				0.025	0.018	-0.037
				(0.048)	(0.041)	(0.028)
Δspouse				dropped	dropped	
Δspouse's health				0.057 *	0.055	
				(0.032)	(0.034)	
constant	-0.022 *	-0.028 *	0.001	-0.017	-0.021	0.002
	(0.011)	(0.015)	(0.014)	(0.012)	(0.015)	(0.014)
Number of obs	81	81	215	78	78	215
F value	6.55	5.36	14.55	4.09	3.83	10.04
Prob > F	0.001	0.002	0.000	0.001	0.001	0.000
R2	0.374	0.373	0.292	0.424	0.426	0.328

Numbers in parentheses indicate standard errors. *** 1% significant, ** 5% significant, * 10% significant
[1] and [4]: the insurance status =1 if a household belongs to either group 1or 2, but otherwise 0. <Treatment A>
[2] and [5]: the insurance status =1 if a household belongs to either group 1, 2 or 3 but otherwise 0. <Treatment B>
[3] and [6]: the insurance status =1 if a man belongs to the employee's insurance program, but otherwise 0. <Treatment C>
Note that there are a few husbands who lost their wife in the balanced panel, so the spouse dummy was dropped in [4] and [5].

Table 7: Estimated Results (Repeated Cross-Section)

independent variables	dependent value: medical cost/expenditure A [1]	B [2]	C [3]	A [4]	B [5]	C [6]
ln(per expenditure)	-0.051 ***	-0.052 ***	-0.069 ***	-0.066 ***	-0.068 ***	-0.094 ***
	(0.012)	(0.012)	(0.010)	(0.014)	(0.013)	(0.011)
year (2003=1)	0.001	-0.009	-0.011	0.007	-0.007	-0.010
	(0.011)	(0.012)	(0.011)	(0.011)	(0.012)	(0.011)
insurance status	-0.021 *	-0.012	-0.030 ***	-0.020	-0.014	-0.021 *
	(0.012)	(0.013)	(0.011)	(0.012)	(0.014)	(0.011)
insurance status×year	0.017	0.037 **	0.030 *	0.008	0.038 **	0.030 **
	(0.019)	(0.019)	(0.016)	(0.018)	(0.018)	(0.015)
# of family				-0.015 **	-0.015 ***	-0.026 ***
				(0.006)	(0.006)	(0.004)
own health				-0.032 *	-0.031 *	-0.026 *
				(0.016)	(0.016)	(0.014)
work				0.036 ***	0.026 **	0.005
				(0.013)	(0.012)	(0.013)
spouse				0.038	0.039	
				(0.024)	(0.024)	
spouse's health				-0.055 **	-0.055 **	
				(0.021)	(0.022)	
constant	0.311 ***	0.316 ***	0.409 ***	0.427 ***	0.446 ***	0.608 ***
	(0.053)	(0.054)	(0.045)	(0.070)	(0.071)	(0.061)
Number of obs	392	392	733	385	385	721
F value	5.846	5.375	13.949	6.375	6.665	14.294
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
R2	0.100	0.106	0.140	0.179	0.184	0.199

Numbers in parentheses indicate standard errors. *** 1% significant, ** 5% significant, * 10% significant
[1] and [4]: the insurance status =1 if a household belongs to either group 1or 2, but otherwise 0. <Treatment A>
[2] and [5]: the insurance status =1 if a household belongs to either group 1, 2 or 3 but otherwise 0. <Treatment B>
[3] and [6]: the insurance status =1 if a man belongs to the employee's insurance program, but otherwise 0. <Treatment C>
The OLS model is estimated using the repeated cross-section data.

Table 8: Estimated Results (First Difference Estimation): 61 years of age or older

	dependent value: Δ(medical cost/expenditure)					
independent	A	B	C	A	B	C
variables	[1]	[2]	[3]	[4]	[5]	[6]
Δln(per expenditure)	-0.141 ***	-0.144 ***	-0.143 ***	-0.157 ***	-0.158 ***	-0.146 ***
	(0.032)	(0.033)	(0.024)	(0.033)	(0.033)	(0.026)
Δinsurance status	-0.017	0.011	0.024	0.016	0.023	0.027
	(0.035)	(0.024)	(0.020)	(0.028)	(0.025)	(0.020)
Δinsurance status×year	0.026	0.018	0.023	0.013	0.013	0.020
	(0.035)	(0.029)	(0.026)	(0.039)	(0.028)	(0.027)
Δ# of family				-0.044 *	-0.041 *	-0.011
				(0.026)	(0.024)	(0.016)
Δown health				-0.020	-0.020	-0.036
				(0.063)	(0.062)	(0.039)
Δ work				0.019	0.013	-0.001
				(0.043)	(0.042)	(0.022)
Δspouse				dropped	dropped	
Δspouse's health				0.025	0.025	
				(0.048)	(0.047)	
constant	-0.028 *	-0.027	-0.008	-0.023	-0.023	-0.006
	(0.015)	(0.018)	(0.015)	(0.016)	(0.019)	(0.015)
Number of obs	51	51	138	50	50	138
F value	8.34	8.74	12.28	4.99	6.16	7.03
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
R2	0.519	0.519	0.351	0.559	0.560	0.358

Numbers in parentheses indicate standard errors. *** 1% significant, ** 5% significant, * 10% significant

[1] and [4]: the insurance status =1 if a household belongs to either group 1or 2, but otherwise 0. <Treatment A>

[2] and [5]: the insurance status =1 if a household belongs to either group 1, 2 or 3 but otherwise 0. <Treatment B>

[3] and [6]: the insurance status =1 if a man belongs to the employee's insurance program, but otherwise 0. <Treatment C>

Note that there are a few husbands who lost their wife in the balanced panel data, so the spouse dummy was dropped in [4] and [5].

Table 9: Estimated Results (Repeated Cross-Section): 61 years of age or older

	dependent value: medical cost/expenditure					
independent	A	B	C	A	B	C
variables	[1]	[2]	[3]	[4]	[5]	[6]
ln(per expenditure)	-0.059 ***	-0.059 ***	-0.072 ***	-0.082 ***	-0.085 ***	-0.102 ***
	(0.015)	(0.015)	(0.012)	(0.017)	(0.017)	(0.014)
year (2003=1)	-0.007	-0.013	-0.017	-0.002	-0.008	-0.013
	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.012)
insurance status	-0.027	-0.008	-0.030 **	-0.021	0.004	-0.023
	(0.017)	(0.019)	(0.013)	(0.017)	(0.018)	(0.014)
insurance status×year	0.022	0.031	0.034 *	0.015	0.030	0.031 *
	(0.024)	(0.023)	(0.018)	(0.023)	(0.021)	(0.017)
# of family				-0.021 ***	-0.022 ***	-0.029 ***
				(0.007)	(0.006)	(0.005)
own health				-0.039 **	-0.041 **	-0.027 *
				(0.018)	(0.018)	(0.015)
work				0.030 **	0.014	0.004
				(0.015)	(0.013)	(0.014)
spouse				0.025	0.023	
				(0.029)	(0.029)	
spouse's health				-0.048 *	-0.050 *	
				(0.027)	(0.027)	
constant	0.350 ***	0.347 ***	0.425 ***	0.533 ***	0.554 ***	0.651 ***
	(0.068)	(0.070)	(0.055)	(0.090)	(0.090)	(0.074)
Number of obs	275	275	503	271	271	494
F value	4.994	3.923	9.759	5.140	5.248	10.328
Prob > F	0.001	0.004	0.000	0.000	0.000	0.000
R2	0.133	0.136	0.154	0.244	0.254	0.220

Numbers in parentheses indicate standard errors. *** 1% significant, ** 5% significant, * 10% significant

[1] and [4]: the insurance status =1 if a household belongs to either group 1or 2, but otherwise 0. <Treatment A>

[2] and [5]: the insurance status =1 if a household belongs to either group 1, 2 or 3 but otherwise 0. <Treatment B>

[3] and [6]: the insurance status =1 if a man belongs to the employee's insurance program, but otherwise 0. <Treatment C>

The OLS model is estimated using the repeated cross-section data.

Table 10: Quantile Regression Results

		[1] A		[2] B		[3] C	
medical cost/expenditure		Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
q10	ln(per expenditure)	-0.020	(0.002) ***	-0.019	(0.002) ***	-0.023	(0.001) ***
	year (2003=1)	0.005	(0.003)	0.000	(0.004)	0.002	(0.002)
	insurance status	0.000	(0.004)	-0.003	(0.005)	-0.002	(0.003)
	insurance status×year	-0.006	(0.005)	0.003	(0.005)	-0.001	(0.003)
	# of family	-0.006	(0.001) ***	-0.005	(0.001) ***	-0.007	(0.001) ***
	own health (=1)	-0.008	(0.003) **	-0.008	(0.004) **	-0.007	(0.002) ***
	work (=1)	0.007	(0.003) ***	0.007	(0.003) **	0.006	(0.002) ***
	spouse (=1)	0.003	(0.006)	0.006	(0.006)		
	spouse's health (=1)	-0.003	(0.004)	-0.007	(0.004)		
q25	ln(per expenditure)	-0.029	(0.003) ***	-0.029	(0.003) ***	-0.036	(0.002) ***
	year (2003=1)	0.006	(0.004)	0.004	(0.004)	0.002	(0.003)
	insurance status	-0.004	(0.005)	-0.004	(0.005)	-0.001	(0.004)
	insurance status×year	0.001	(0.007)	0.004	(0.006)	0.006	(0.005)
	# of family	-0.010	(0.001) ***	-0.010	(0.001) ***	-0.011	(0.001) ***
	own health (=1)	-0.013	(0.004) ***	-0.014	(0.004) ***	-0.014	(0.003) **
	work (=1)	0.018	(0.004) ***	0.018	(0.004) ***	0.008	(0.003)
	spouse (=1)	-0.003	(0.008)	-0.003	(0.008)		
	spouse's health (=1)	-0.006	(0.005)	-0.005	(0.005)		
q50	ln(per expenditure)	-0.042	(0.004) ***	-0.042	(0.005) ***	-0.057	(0.004) ***
	year (2003=1)	0.009	(0.005) **	0.003	(0.007)	-0.001	(0.006)
	insurance status	-0.008	(0.006)	-0.007	(0.009)	-0.008	(0.007)
	insurance status×year	-0.008	(0.009)	0.008	(0.011)	0.012	(0.009)
	# of family	-0.011	(0.002) ***	-0.012	(0.003) ***	-0.018	(0.002) ***
	own health (=1)	-0.017	(0.005) ***	-0.014	(0.007) **	-0.024	(0.006) ***
	work (=1)	0.026	(0.005) ***	0.020	(0.007) ***	0.004	(0.006)
	spouse (=1)	0.000	(0.010)	0.010	(0.013)		
	spouse's health (=1)	-0.032	(0.006) ***	-0.035	(0.009) ***		
q75	ln(per expenditure)	-0.055	(0.010) ***	-0.061	(0.011) ***	-0.097	(0.013) ***
	year (2003=1)	0.012	(0.011)	0.000	(0.013)	-0.002	(0.015)
	insurance status	-0.032	(0.015) **	-0.005	(0.016)	-0.019	(0.019)
	insurance status×year	0.023	(0.020)	0.025	(0.019)	0.007	(0.024)
	# of family	-0.010	(0.005) **	-0.011	(0.005) **	-0.027	(0.006) ***
	own health (=1)	-0.039	(0.011) ***	-0.045	(0.012) ***	-0.025	(0.015) *
	work (=1)	0.033	(0.012) ***	0.021	(0.013)	0.022	(0.016)
	spouse (=1)	0.038	(0.022) *	0.039	(0.023) *		
	spouse's health (=1)	-0.079	(0.014) ***	-0.087	(0.015) ***		
q90	ln(per expenditure)	-0.109	(0.038) ***	-0.114	(0.035) ***	-0.150	(0.037) ***
	year (2003=1)	0.024	(0.032)	0.002	(0.033)	-0.038	(0.040)
	insurance status	-0.003	(0.044)	0.026	(0.040)	-0.070	(0.048)
	insurance status×year	-0.001	(0.059)	0.033	(0.051)	0.067	(0.061)
	# of family	-0.018	(0.016)	-0.015	(0.015)	-0.027	(0.014) *
	own health (=1)	-0.092	(0.035) ***	-0.084	(0.033) **	-0.034	(0.040)
	work (=1)	0.070	(0.033) **	0.040	(0.033)	0.022	(0.042)
	spouse (=1)	0.207	(0.064) ***	0.176	(0.058) ***		
	spouse's health (=1)	-0.233	(0.044) ***	-0.232	(0.038) ***		
	Number of obs	385		385		721	
	.10 Pseudo R2	0.076		0.073		0.077	
	.25 Pseudo R2	0.089		0.089		0.087	
	.50 Pseudo R2	0.113		0.109		0.101	
	.75 Pseudo R2	0.141		0.144		0.134	
	.90 Pseudo R2	0.193		0.200		0.161	

Numbers in parentheses indicate standard errors. *** 1% significant, ** 5% significant, * 10% significant

[1]: the insurance status =1 if a household belongs to either group 1or 2, but otherwise 0. <Treatment A>

[2]: the insurance status =1 if a household belongs to either group 1, 2 or 3 but otherwise 0.<Treatment B>

[3]: the insurance status =1 if a man belongs to the employee's insurance program, but otherwise 0.<Treatmen C>

The quantile regression model is estimated using the repeated cross-section data.

Table 11: Quantile Regression Results: 61 years of age or older

		[1] A		[2] B		[3] C	
medical cost/expenditure		Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
q10	ln(per expenditure)	-0.020	(0.002) ***	-0.022	(0.002) ***	-0.026	(0.002) ***
	year (2003=1)	0.001	(0.004)	0.000	(0.004)	0.001	(0.003)
	insurance status	-0.005	(0.006)	-0.006	(0.006)	-0.005	(0.005)
	insurance status×year	0.002	(0.007)	0.009	(0.007)	0.002	(0.006)
	# of family	-0.005	(0.001) ***	-0.006	(0.002) ***	-0.008	(0.001) ***
	own health (=1)	-0.009	(0.004) ***	-0.008	(0.004) **	-0.012	(0.003) ***
	work (=1)	0.009	(0.003) ***	0.008	(0.004) **	0.008	(0.003) **
	spouse (=1)	0.006	(0.008)	0.007	(0.009)		
	spouse's health (=1)	-0.010	(0.005) **	-0.009	(0.005) *		
q25	ln(per expenditure)	-0.033	(0.003) ***	-0.034	(0.003) ***	-0.039	(0.002) ***
	year (2003=1)	0.006	(0.004)	0.006	(0.004)	0.000	(0.004)
	insurance status	-0.005	(0.006)	0.002	(0.006)	-0.001	(0.006)
	insurance status×year	0.002	(0.008)	0.001	(0.007)	0.008	(0.007)
	# of family	-0.011	(0.002) ***	-0.011	(0.002) ***	-0.011	(0.001) ***
	own health (=1)	-0.015	(0.004) ***	-0.013	(0.004) ***	-0.015	(0.004) ***
	work (=1)	0.019	(0.004) ***	0.016	(0.004) ***	0.009	(0.004) **
	spouse (=1)	-0.004	(0.008)	-0.005	(0.008)		
	spouse's health (=1)	-0.005	(0.005)	-0.002	(0.005)		
q50	ln(per expenditure)	-0.049	(0.004) ***	-0.048	(0.005) ***	-0.059	(0.005) ***
	year (2003=1)	0.007	(0.005)	0.004	(0.007)	-0.001	(0.007)
	insurance status	-0.006	(0.008)	-0.002	(0.010)	-0.004	(0.010)
	insurance status×year	-0.005	(0.010)	0.009	(0.012)	0.011	(0.012)
	# of family	-0.015	(0.002) ***	-0.016	(0.003) ***	-0.018	(0.003) ***
	own health (=1)	-0.020	(0.005) ***	-0.020	(0.007) ***	-0.027	(0.007) ***
	work (=1)	0.023	(0.005) ***	0.018	(0.007) **	0.001	(0.007)
	spouse (=1)	0.017	(0.009) **	0.013	(0.013)		
	spouse's health (=1)	-0.026	(0.006) ***	-0.027	(0.009) ***		
q75	ln(per expenditure)	-0.069	(0.015) ***	-0.069	(0.009) ***	-0.103	(0.011) ***
	year (2003=1)	0.007	(0.015)	0.002	(0.010)	-0.011	(0.013)
	insurance status	-0.028	(0.025)	0.007	(0.015)	-0.013	(0.019)
	insurance status×year	0.022	(0.030)	0.024	(0.016)	0.013	(0.022)
	# of family	-0.018	(0.008) **	-0.014	(0.005) ***	-0.032	(0.006) ***
	own health (=1)	-0.048	(0.016) ***	-0.051	(0.010) ***	-0.027	(0.013) **
	work (=1)	0.028	(0.015) *	0.008	(0.010)	0.008	(0.013)
	spouse (=1)	0.035	(0.029)	0.030	(0.017) *		
	spouse's health (=1)	-0.071	(0.019) ***	-0.072	(0.012) ***		
q90	ln(per expenditure)	-0.149	(0.039) ***	-0.133	(0.039) ***	-0.149	(0.046) ***
	year (2003=1)	0.008	(0.032)	0.010	(0.033)	-0.029	(0.046)
	insurance status	-0.023	(0.050)	0.017	(0.048)	-0.055	(0.067)
	insurance status×year	0.003	(0.062)	0.011	(0.056)	0.072	(0.079)
	# of family	-0.018	(0.014)	-0.016	(0.014)	-0.035	(0.016) **
	own health (=1)	-0.076	(0.034) **	-0.092	(0.033) ***	-0.012	(0.046)
	work (=1)	0.060	(0.034) *	0.039	(0.033)	0.022	(0.048)
	spouse (=1)	0.211	(0.063) ***	0.184	(0.054) ***		
	spouse's health (=1)	-0.271	(0.042) ***	-0.260	(0.044) ***		
	Number of obs	271		271		494	
	.10 Pseudo R2	0.095		0.095		0.082	
	.25 Pseudo R2	0.101		0.100		0.093	
	.50 Pseudo R2	0.123		0.119		0.111	
	.75 Pseudo R2	0.161		0.170		0.155	
	.90 Pseudo R2	0.257		0.261		0.185	

Numbers in parentheses indicate standard errors. *** 1% significant, ** 5% significant, * 10% significant
[1]: the insurance status =1 if a household belongs to either group 1or 2, but otherwise 0. <Treatment A>
[2]: the insurance status =1 if a household belongs to either group 1, 2 or 3 but otherwise 0.<Treatment B>
[3]: the insurance status =1 if a man belongs to the employee's insurance program, but otherwise 0.<Treatmen C>
The quantile regression model is estimated using the repeated cross-section data.

Figure 1: Overview of The 2003 Health Insurance Reform in Japan

Before the 2003 health insurance reform

<table>
<tr><td>Over 70 years of age</td><td colspan="3">10%</td></tr>
<tr><td>0 - 69 years of age</td><td>insured person
20%</td><td>dependent
outpatient
30%
inpatient
20%</td><td>30%</td></tr>
<tr><td></td><td colspan="2">employees' health insurance</td><td>national health insurance</td></tr>
</table>

⇒

After the 2003 health insurance reform

<table>
<tr><td>Over 70 years of age</td><td colspan="2">10%</td></tr>
<tr><td>3 - 69 years of age</td><td colspan="2">30%</td></tr>
<tr><td>0 - 2 years of age</td><td colspan="2">20%</td></tr>
<tr><td></td><td>employees' health insurance</td><td>national health insurance</td></tr>
</table>