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First, as expected, there is some substitutability between commercial drugs and doctor's treatment. The degree of substitutability is not negligible.

Second, the substitutability depends on household income. The degree of substitutability is higher at the lowest income group than the other group. Thus to promote the policy to cut medical cost trough improving the accessibility of commercial drug, some attention to the poor is necessary.

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*JEL classification numbers*: I12, C30
*Keywords*: Medical expenditure, Bivariate Model, Substitute goods

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# 1 Introduction

In Japan, explosion of medical care cost has been pressing issue. In 2008, medical expenditure of Japan is about three and a half trillion yen and equals about 10% of national income. Only twenty years ago, medical expenditure of Japan was about two trillion yen and equalled about only 6% of national income. Thus both index has doubled in this twenty years. In addition, most experts of social security predict further increase in the near future.

The reason why medical care cost has been risen is severalfold. The first and most important reason is aging of society. In 1990, fraction of who are equal or over 65 is only about 12%, however, in 2010, about 23% of Japanese are equal or over 65 and thus population aging rate has doubled through this twenty years. At least on average, the elder are less healthier than the young and the elder need more medical care than the young.

The second reason is breakthrough in medical technology. Tuberculosis is a good example. Just thirty or forty years ago, tuberculosis is considered as fatal disease, however, in recent years, "Early detection and rapid cure" can completely overcome tuberculosis. Many people's lives are saved itself a blessing event, however, how we finance the cost of such cutting-edge medical technology remains to be resolved.

The third reason is so called physician-induced demand in the literature. There are already vast amount of literature in Japan (Noguchi et al. (2005)). Physicians have more medical knowledge and/or information than other people. Medical technology has become more and more highly-developed and speed of the progress has become more and more rapid. Consequently, degree of asymmetry becomes more severe. Under such a symmetry, physician *can* (not necessarily do so) provide excessive care which is actually not in need. Too-much care is problematic at least in terms of exploding medical care cost.

Above argument indicates the mechanism behind exploding medical care cost is severalfold and hard to be dealt with. However, some effort has been already made. The first and perhaps most famous policy is comprehensive payment system. The second example is pulling out coinsurance rate of medical costs for the elderly. The third effort is concerning market for a drug.

While the effect of the first (Nawata et al. (2009)) and the second (Kan and Suzuki (2006)) trial have been empirically examined, the third trial has not been fully examined yet compared to the other two trial. The main reason why the registered salesclerk system has not been empirically examined is lack of suitable data.

Aim of the registered salesclerk system is improve availability of drugs and promote substituting commercial drugs for doctor's treatment as already noted. Thus examining the substitutability of commercial drugs and doctor's treatment is an implicit verification of the effectiveness of the third trial. Suzuki and Okusa (2000) and Okusa and Ii (2002) are the examples of empirical studies which examine the substitutability. While the existence of the substitutability is verified, the degree is not. To quantitatively evaluate the substitutability, information about the degree of the substitutability is indispensable.

Thus in this paper, using Japanese Household Panel Survey (JHPS), we empirically examine whether the registered salesclerk system has impact on actual behavior. To be more precise, we empirically examine whether there is substitutability between doctor's treatment and commercial drugs. In addition, we examine the relationship between income and substitutability. As we will note later, implication of substitutability depends on the relationship.

Main results in this paper are as below. First, our estimation results is very strong

evidence for substitutability between doctor's treatment and commercial drugs. The substitutability implies there is a possibility improvement of the availability of commercial drugs somehow cut medical cost in Japan. Second, we find the degree of substitutability depends on income. To be more precise, the poor people are, the larger the substitutability is. Considering the rich are on average healthier than the poor, there is a possibility the richer consume too large amount of medical resources or the poor consume too little.

This paper is organized as follows. In the next section, we briefly refer to theoretical background of this paper. And in the third section, we provide analytical framework. We present empirical results in the fourth section and the last section is our conclusion.

# 2 Background

In this paper, we empirically examine the relationship between medical expenditure. We provide brief explanations below.

In some earlier studies, existence of substitutability is already confirmed. The reason why there may be substitutablity exists is as follows. For example, when we catch a cold, roughly speaking, two alternatives are at our hand[1].

The first and more careful (sometimes anxious) behavior is seeing a doctor. Prescription drug often more rapidly and efficiently remedy your cold and in addition, medical examination provides us sense of security. Thus we are apt to see a doctor even when it is not necessary.

The second and more optimistic (sometimes rational) behavior is going to drugstore and buying commercial drugs. In most cases commercial drugs also sufficiently remedy our cold. Sometimes commercial drugs are not enough to remedy our cold, however, in most cases it is not too late to see a doctor then. Opportunity cost is also a problem.

In sum, there may be substitutability between doctor's treatment and commercial drugs when state of disease is not so severe. In Japan, some earlier studies written in Japanese has already exaimned the existence of the availability. Suzuki and Okusa (2000) and Okusa and Ii (2002) are examples. However, they have not examined the degree of the substitutability. For quantitative discussion, some information about the degree is necessary.

In addition, relationship between the substitutability and income is also an important issue. The reason why the relationship between them is important is as follows. If there is positive correlation between the substitutability and income, it seems not so problematic. In contrast, if there is negative relationship, it is not the case.

Under such situation, at least either of the two cases below hold. The first case is the rich consume too large amount of medical resource. This means the rich do not quit consulting a doctor even if commercial drugs they have bought fully cure them. On the contrary, the second case is the poor consume too little amount of medical resources. This means the poor quit consulting a doctor even if an additional examination besides commercial drugs is necessary.

There are some problems to be solved to conduct an empirical analysis. The first and most important problem is endogeneity. Some sources of endogneity are there.

First, it is no wonder unhealthier people see a doctor more often *and* buy commercial drugs more often. In such a case, spurious correlation is there and if we employ a simple regression model, this attenuate the effect of the expenditure on commercial drugs on

[1]There is also a possibility we do not anything. However, we exclude such a possibility here to make the argument more simple.

expenditure to doctors. To avoid such a case, controlling the health conditions of an individual as possible is necessary.

The second source is other characteristics of people. For example, educational background of people affect health investment behavior of people (Cutler and Lleras-Muney (2006)). Needless to say, people's income affect their investment to health. Other than education and income, people's risk attitude, gender, and age also may have some effect.

In Japan, number of large scale socioeconomic researches including detailed information about people's health (both self rated and objective) , socioeconomic status (e.g. education), and preference (e.g. risk attitude). Thus even if we control effect of all available individual characteristics which may affect medical expenditure, some source of endogneity remains.

In such a case, instrumental variable approach is effective. The problem is choice of the instrument. Many earlier studies find density of hospital per capita or per area affects individuals' probability of taking medical treatment. An empirical example in Japan is Izumida et al. (1998). Léonard et al. (2009) is a comprehensive survey of the literature. Municipality level density of doctor is available and we use this measure as instrumental variable.

There is a factor which earlier studies has overlooked though may have effect on medical expenditure. Even if people's health become worse, large amount of time is necessary to see a doctor. And available time crucially depends on labor hour of them. Thus we make hypothesis as follows. People's labor hour has positive effect on expenditure to commercial drugs and negative effect on to doctor's treatment. The mechanism behind is too busy people buy commercial drugs instead of doctor's treatment because this alternative is more time-saving.

# 3 Analytical framework

## 3.1 Empirical model

In this paper, we simultaneously estimate expenditure to doctor's treatment and to commercial drugs. As to how we simultaneously estimate two equations, roughly speaking, two alternatives are there. The former is two stage estimation and the latter is simultaneous estimation. Implementing the former is more straightforward than the latter, however, this easiness is in exchange for efficiency loss. Concretely speaking, two stage estimation can be implemented with some simplifying assumption as to structure of variance-covariance matrix. The efficiency loss can be avoided with some correction, however, if we concern not only consistency but efficiency, simultaneously estimate from the outset is better alternative. Thus we employ simultaneous estimation and estimation equations are as below.

In the first specification, we include expenditure to commercial drugs as an explanatory variable of expenditure to doctor's treatment.

$$
\begin{aligned}
y^*_{d,i} &= \mathbf{y_{c,i}}'\boldsymbol{\alpha} + \mathbf{x}'_{d,i}\boldsymbol{\beta}_d + \epsilon_{d,i}, \quad i = 1, \cdots, n, \\
y^*_{c,i} &= \mathbf{x}'_{c,i}\boldsymbol{\beta}_c + \epsilon_{c,i}, \quad i = 1, \cdots, n, \\
\begin{bmatrix} \epsilon_{d,i} \\ \epsilon_{c,i} \end{bmatrix} &\sim \mathcal{N}\left[ \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix} \right],
\end{aligned}
$$

$$y_{l,i} = \begin{cases} y^*_{l,i} & if \quad y^*_{l,i} > 0 \\ 0 & if \quad y_{l,i} \leq 0 \end{cases}, \quad l = d, c.$$

Where subscript d indicates expenditure to doctor's treatment, c indicates expenditure to commercial drugs, respectively. Our first concern is whether estimate of $\alpha$ in the above equation is significantly different from zero or not. In the former case, estimation results is evidence for substitutability and in the latter case, estimation results is evidence against substitutability. Other concern is whether estimate of $\rho$ in the above equation is significantly different from zero or not.

## 3.2 Data

We use the first (2009) and the second (2010) waves of the Japanese Household Panel Survey (JHPS) to examine whether there are substitutability between doctor's treatment and commercial drugs. JHPS is conducted first by Keio University Joint Research Center for Panel Studies in January 2009 and conducted in subsequent years. Advantage of using this survey in our study are as below.

First, it provides us about individuals' expenditure to both doctor's treatment and commercial drugs. In JHPS, expenditure to both doctor's treatment and commercial drugs are asked as follows.

*"Did you spend some money to remedy your disease and/or injuries in the last year? Please put a ring around relevant number. If you spent any, please also write how much your copayment is in the last year. ( Even if you receive refund of expensive medical charge, please write how money much you paid to clerk of medical agency. )"*

*(a)"How much money did you spent to remedy your disease/injuries in the hospital/clinic? (directly payment to the hospital/clinic, prescription charge through a doctor's prescription and so on)"*

*1.spent some money 2.spent no money*

*amount of money _____ten thousand("man") and _____thousand("sen") yen*

*(b)"How much money did you spent to remedy your disease/injuries by other way? (buy contact lens, medicine for a cold without prescription and so on)"*

*1.spent some money 2.spent no money*

*amount of money _____ten thousand("man") and _____thousand("sen") yen*

As is evident from the above question form, both question are twofold. Thus we readily and certainly distinguish who spent no money and who spent some money.

Second, KHPS provides variety of characteristics of surveyed households. For example, economic situation, family structure, education, employment history, health condition, living environment and so on are asked in KHPS. Health condition is particularly important in this paper. Self-rated health (SRH), chronic conditions and so on are included. We use these variables as explanatory variables. What is worth while to note is there is a suspicion of multicollinearity between SRH and chronic conditions. As SRH is more comprehensive, we estimate with and without chronic condition. In both cases, SRH is controlled.

Third, JHPS is comprehensive panel survey of households in Japan. A few designated statistics and household surveys also provide information about medical expenditure. However, to authors's knowledge, there is no survey provides us expenditure to both doctor's treatment and commercial drugs. Without both information, we cannot accomplish our purpose. In addition, those data don't contain information on their entire life and consequently is not suitable for our purpose it other reason.

Several drawbacks are also there. JHPS is first conducted in 2009 and only two waves are there to date. This drawback mainly matters in terms of sample size. A second drawback is we cannot know respondents' past health status in detail. In an ideal world, respondents' health status from their birth to date is necessary. However, in Japan, no comprehensive household panel studies contain detailed information as to children's health. JHPS also suffers from this drawback and thus we control only current health condition of respondents.

(Table 1 around here)

We provide definition of each variable in table 1. Subsequently, we explain the definition of explanatory variables. Each dummy variable take the value one if respondents apply to the corresponding situation. Labor hour is amount of labor hour per week. Next, individual's subjective risk aversion is defined from the answer for following question.

**"Usually, when you go out, you go out with an umbrella if the probability of rain is over x%"**

We transform the answer for the above question as follows. The reason why we adopt the following transformation is we can interpret empirical results is more easily.

$$SubjectiveRiskAversion = 100 - theanswerfortheabovequestion(\%)$$

What need attention most is accessibility. The reason is there is no available statistic which collects number of pharmacies in each municipality. We therefore gain approximate value of number of pharmacies in each municipality as follows. Firstly, we gain number of pharmacists in each prefecture from Survey of Physicians, Dentists and Pharmacists(SPDP) (a). Secondly, we gain number of pharmacies in each prefecture from Report on Public Health Administration and Services (b). Thirdly, from (a) and (b), we calculate average number of pharmacists in each pharmacy by prefecture (c). Next, we gain number of pharmacists in each municipality from SPDP (d). At last, we multiply (c) by (d) and gain approximate value of number of pharmacies in each municipality. As to number of beds, SPDP tells us exact numbers and no device is in need.

(Table 2 around here)

Descriptive statistics of variables included in the analysis are provided in table 2. A few points are worth while to note. Firstly, average expenditure to doctor's treatment is larger than to commercial drugs. And secondly, variance of availability is very large. As is expected from the debate concerning doctorless municipalities, some people live in town or village where there is no hospital and/or drugstore.

# 4 Empirical results

Empirical results are in table3. We provide detailed results and possible explanation below.

## 4.1 Without detailed health condition

Firstly, we provide detailed results and possible explanation when we employ the first specification. As is already noted, in the first specification, expenditure to doctor's treatment is "main" equation and expenditure to commercial drugs is "sub" equation.

(Table 3 around here)

Empirical results when we use pooled sample is in second and fourth columns of table3 and marginal effects are in third and fifth columns. What we should note first is whether there is substitutability between commercial drugs and doctor's treatment. From second column of table3, estimate of commercial drug is significantly negative and significant level is 5%. This result imply there is in fact substitutability between commercial drugs and doctor's treatment. We must calculate marginal effects to argue the result quantitatively. Marginal effects are provided in table3. Unit of expenditure to doctor's treatment and commercial drugs are both Japanese yen. Thus if one's expenditure to commercial drugs increase by ten thousand yen, same person's expenditure to doctor's treatment decrease by about five thousand yen. Whether one regards this effect large or not depends on one's view, however, this is not negligible results.

Secondly important result is substitutability depends on income. In terms of marginal effect, if one's household income is equal or under two million yen, ten thousand yen increase of expenditure to commercial drugs decreases same person's expenditure to doctor's treatment decrease by about nine thousand yen. This is about two times larger than those of people in other income classes. This result implies there is a possibility the poor invest too less amount of money in their health.

Next, error terms of both equations are correlated and significant level is 0.1%. This seems plausible. The problem here is not whether there is correlation but what is behind the correlation. As to the problem, providing complete and unanimous answer is beyond the scope of this paper. Nevertheless, we exclude some alternatives. Individual or household characteristics as gender, age, income, educational background, and total health condition and so on are all included in explanatory variables and thus cannot be cause of correlation. Other than them, individual knowledge or attitude as to health is likely scenario though JHPS does not provide such information. Consequently, we cannot confirm whether knowledge and/or attitude is behind the correlation.

Thirdly, educational background indeed matters. In both equations, estimates of educational background dummies are significant and the sign is positive as expected. Marginal effects are order of thousand yen in both equations. As we also control household income, some factors other than income is necessary to interpret the result. The first and most

plausible explanation is individuals' unobserved preference. Among variety of preferences, most hopeful one is time preference. Some earlier studies point out there is not negligible connection between time preference and educational background and also strong connection between time preference and health related behaviors. There is also a possibility risk attitude used as to rain and as to health considerably differ. The second explanation is health knowledge. If highly educated people have, at least on average, more abundant health knowledge and health knowledge enhance investment in health, our result can be explained. Regardless of what is a most appropriate scenario, the implication is educational disparity also leads to health disparity. We should remember this disparity is not necessarily undesirable from equality. There is a possibility highly educated people simply waste medical resources and less educated people consume appropriately. If this is the case, how we hamper wasteful spending is an issue.

And next, availability also matters to each expenditure. Number of beds for general patients per unit habitable area in each municipality has positive effect on expenditure to doctor's treatment and number of pharmacies per unit habitable area in each municipality has positive effect on expenditure to commercial drugs. This is a plausible result. What plausible means is if medical resources per unit habitable area is large, people can easily access them.

One's labor hour has significantly negative effect on expenditure to doctor's treatment and positive but not significant effect on expenditure to commercial drugs. Thus short time worker see a doctor more often than long time worker. People usually work daytime and hospitals also opens daytime is the reason.

Effects of self rated health is also as expected. The worse their health condition become, the more amount of money they spend to their health. What we should take care of is, total effect of health condition is incomprehensible if we look marginal effects of the first equation alone. If one's SRH goes from best (SRH=1) into worst (SRH=5), direct effect of health condition is about sixty nine thousand yen. Indirect effect is about 4.5 thousand (8.9 times 0.50) yen. Total effect is over seventy thousand yen. From the same calculation, If one's SRH gets a little worse (SRH=1 to SRH=2), total effect on expenditure to doctor's treatment is about nine thousand yen. From a viewpoint of households, this is perhaps negligible, however, from a viewpoint of national health expenditure, this is not negligible. The result thus implies importance of health maintenance as possible to hold down national health expenditure.

## 4.2 With detailed health condition

Comparing results in table 3 and table 3, there are a few differences but results are almost the same. Thus we mainly focus on what differs from table 3 and briefly remaining results.

Firstly, and most importantly, estimate of expenditure to commercial drugs is significant and the sign is negative. The magnitude is also almost the same. Thus our results strongly support the substitutability.

Secondly, the relationship between income and the substitutability also remains the same. Thus this result is also robust.

Thirdly, estimate of $\rho$ is significant and the sign is positive. Significant level is over 0.1% and all results are almost the same results as results in table**??**.

Fourthly, as availability, results are almost the same. However, the effect of accessibility of doctor's treatment turns into insignificant. This result implies true accessibility is

different from per area medical resources in each municipality. Amount of time required to nearest clinic or hospital is possibly the desirable alternative.

Most striking change is effect of SRH. First issue is effect of SRH. Firstly, as to expenditure to doctor's treatment, effect of self assessed health seems almost the same as results in table3. Reduction rate of effect is about twenty percent and seems modest. On the contrary, as to expenditure to commercial drugs, there is a striking difference as to effect of self assessed health compared to table3.

What is different when people see a doctor and buy commercial drugs is severity of their health problems. On average, health problems is more severe in the former case than the latter case. Thus these result implies in case of severe health problems, degree of multicollinearity is modest. On the contrary, in case of severe health problems, degree of multicollinearity is strong.

Effect of SRH does not entirely disappear even if we control more detailed conditions. Therefore, we reconfirm the two implication as to SRH. The first one is SRH tells us some aspect of health what we cannot know from other indicators. This is often pointed out in medical studies. The second one is, on the contrary, SRH is an integrative indicator of health and more detailed conditions tell us some fraction of information SRH tells us.

Next issue is effect of chronic conditions themselves. We first check up the first equation. Among chronic condition variables, having back problem or cold have significant effect. The sign of these variables are as expected. What are behind this result is those conditions, in comparison with other conditions, are more strongly connected with specific diseases.

We subsequently check up the second equation. What have significant effect are headache, cold, and back problem. Except headache, this is the same with the case of doctor's treatment. The reason is possibly also the same. As for mild or middle degree of headache, headache medication may sufficiently do good.

# 5 Conclusion

This paper empirically investigate whether commercial drugs are substitute goods of doctor's treatment using KHPS. Main findings of this paper and implication of these findings are as follows.

First, empirical results in this paper strongly support the hypothesis commercial drugs are substitute goods of doctor's treatment and the result does not depend on how we control individuals' health condition. More precisely speaking, when we estimate simultaneously both equations we include either of dependent variables as explanatory variables for the other (but not simultaneously so), estimate of those are significantly negative.

Implication of this substitutability is as follows. First, substitutability as confirmed in this paper make contribution to save limited medical resources. The reason is very straight forward. To be checked by a doctor, at least a few medical service workers are necessary while to purchase commercial drug, only a clerk is in need. From the viewpoint of manpower, if most of Japanese refrain from consulting a doctor more than is necessary and purchase commercial drugs instead, considerable amount of medical resources is saved.

What remains to be solved is whether commercial drugs can truly complement doctor's treatment from medical point of view. In more medical words, whether commercial drugs remedy one's injury and disease as doctors and prescription drug do. The answer perhaps crucially depends on the meaning of injury and disease. If one's health is severely damaged, usage of commercial drugs without advice from medical professionals may sometimes

harm health. However, if one's health is only somewhat damaged, commercial drugs can complement doctors and prescription drug.

Secondly, the substitutability depends on income. The substitutability is about two times larger among the poor (whose household income is equal or less than two million yen). Considering pure income effect is also significant, there is a possibility the poor invest too little amount of money in health. Health disparity between the poor and the rich may stem from this fact.

Thirdly, when estimating both expenditures, error terms of both equations are significant in all cases. The sign are positive in all cases and thus this result make some contribution to the literature from the viewpoint of studying complected relationship between health behaviors. Some previous literature already find correlation of error terms of various health related behaviors though expenditure to commercial drugs and doctor's treatment is not an issue of them. In terms of health production function, there is a strong possibility some invest in health excessively while others not. As Grossman (1972) notes, production of health is recursive process and thus if difference of health investment behavior in single year is not too large, it will result in much difference of health in the long run. Relationship between medical expenditure and harmful behavior such as smoking and overeating (obesity) is also an important issue. If addicts are who spend less relative to their health condition, their health will more and more worsen and consequently their medical cost will also run up.

Fourthly, this paper reconfirms who are highly educated invest more in health. This finding is almost in line with the literature (Cutler and Lleras-Muney (2006)). For example, Cutler and Glaeser (2005) finds highly educated people smoke less than others and Molla et al. (2004) finds highly educated people on average live longer than others. Results in this paper indicates results as the latter can be somewhat explained by difference of medical expenditure behavior between highly educated and less educated. This result has several implications both to human capital policy and socioeconomic disparity.

As to human capital policy, implication is as below. If education promote one's health from somewhat reason, decision making as to how much one invests in education without considering effect on health leads to underinvestment in health. What is available to policy makers is limited though reconsidering health education in school is example of possible strategy. If future studies succeed in explaining more precisely what is behind relationship between health and education, number of alternative policies will increase. As to the latter issue, if health disparity is not only the result but the cause of disparity in other aspects, health is the key factor behind glowing (or to be glow in the future) socio economic disparity.

There are also few issues to be resolved in future research. The first and perhaps most important issue is we should conduct more studies to examine what kind of treatment can be substituted by commercial drugs and what cannot be. In this paper, for instance, whether individuals have caught a cold has significant effect of both expenditure. Therefore, at least if degree of cold is not severe, commercial drugs is substitutable goods for doctor's treatment. However, there are a large amount of disease of which this paper cannot take account. Examining whether there is a substitutability and how this substitutability is strong for each disease is important future research area.

The second issue is dynamics of individuals' medical expenditure behavior. Typically, our behavior as to what type of medical service we purchase is as follows. First, we go to pharmacies and buy some commercial drugs. If we get well, the process ends here. However, if we still feel ill, most people see a doctor and the rest of people buy more effective (at

least it seems to them) drugs. And moreover, through such sequence, we learn what types of drugs are effective in what cases and in what cases we should immediately see a doctor. Analytical framework of this paper does not incorporate such a process.

The third issue is what the correlation of error terms means. Many studies including this study empirically confirm error terms of health related behaviors are significantly correlated, however, these papers fail to sufficiently exhibit what is behind the correlation. Some possible explanations are already proposed and a few studies empirically test whether the explanations are valid though results are mixed. This paper also tests whether risk attitude can fully explain the correlation but the results is negative.

The fourth issue is validity of self medication. Some recent studies examine causes and results of self medication. These paper indicates depending too much on self medication may be harmful for health. If promoting availability of drugs without description as a policy tool to pull in medical expenditure, empirically examining how much degree of self medication is allowable is indispensable part of such a policy. This issue is also related to the first issue.

The fifth issue is as to behavior of elderly people. In this paper, our datasets consist of who are under 70. The reason is there is a difference between coinsurance rate of who are under 70 and of who are over 69. Though limitation of sample size hinders analysis with dataset which consists of people over 69, such extension is in need. Needless to say, the older they become, the more their medical expenditure become.

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Table 1: Definitions of Variables

| | Definition |
|---|---|
| Dependent | |
| EXP_1 | Number of cigarettes a husband (wife) smokes in a day |
| EXP_2 | Drinking frequency of a husband (wife) |
| Independent | |
| AGE | Age of a respondent |
| MALE | takes the value one if a respondent is male |
| HEALTH2 | takes the value one subjective health condition of a respondent is good (2=good) |
| HEALTH3 | takes the value one subjective health condition of a respondent is fair (3=fair) |
| HEALTH45 | takes the value one if subjective health condition of a respondent is bad or very bad(4=bad, 5=very bad) |
| INCOME_200 | takes the value one if annual household income is under two million yen |
| INCOME_400 | takes the value one if annual household income is equal or over two million yen and beyond four million yen |
| INCOME_600 | takes the value one if annual household income is is equal or over four million yen and beyond six million yen |
| INCOME_800 | takes the value one if annual household income is equal or over six million yen and beyond eight million yen |
| INCOME_1000 | takes the value one if annual household income is equal or over ten thousand yen and beyond ten million yen |
| RA | Subjective Risk Aversion(detailed definition is in the body of this paper) |
| EDCOL | takes the value one if a respondent is graduated from junior college or technical college |
| EDUNIV | takes the value one if a respondent is graduated from university |
| Working Hour | How many hours a respondent works in a week |
| HOSP_DENS | number of hospitals per unit area in each second medical area |
| PHAR_DENS | approximate number of pharmacy per unit area in each city/town/village |
| HEL_HEAD | takes the value one if degree of headache and dizziness is less than or equal to two(Rarely). |
| HEL_PALP | takes the value one if Degree of palpitation and breath shortness ($1 \sim 4$) |
| HEL_STOMACK | takes the value one if Degree of stomachache ($1 \sim 4$) |
| HEL_BACK | takes the value one if Degree of backache and shoulder pain ($1 \sim 4$) |
| HEL_TIRE | takes the value one if How often each respondent feels tired ($1 \sim 4$) |
| HEL_COLD | takes the value one if How often each respondent catches a cold ($1 \sim 4$) |
| HEL_SLEEP | takes the value one if Degree of problem with falling asleep ($1 \sim 4$) |
| YD2010 | takes the value one if observation is from JHPS 2010 |

Note: 14 big cities are Sapporo, Sendai, Saitama, Chiba, Tokyo, Kawasaki, Yokohama, Nagoya, Kyoto, Osaka, Kobe, Hiroshima, Kitakyushu, and Fukuoka.

Table 2: Descriptive Statistics

| | Pooled Sample | | | |
|---|---|---|---|---|
| | Mean | Std Dev | Min | Max |
| Dependent | | | | |
| EXP_1 | 30.6010 | 50.8290 | 0 | 385 |
| EXP_2 | 7.4737 | 15.7908 | 0 | 132 |
| Independent | | | | |
| AGE | 46.8130 | 13.8828 | 19 | 69 |
| MALE | 0.5079 | 0.5000 | 0 | 1 |
| HEALTH2 | 0.2629 | 0.4403 | 0 | 1 |
| HEALTH3 | 0.3249 | 0.4684 | 0 | 1 |
| HEALTH45 | 0.0872 | 0.2822 | 0 | 1 |
| EDCOL | 0.1365 | 0.3434 | 0 | 1 |
| EDUNIV | 0.3082 | 0.4618 | 0 | 1 |
| INCOME_200 | 0.0693 | 0.2540 | 0 | 1 |
| INCOME_400 | 0.2132 | 0.4096 | 0 | 1 |
| INCOME_600 | 0.2499 | 0.4330 | 0 | 1 |
| INCOME_800 | 0.1971 | 0.3979 | 0 | 1 |
| INCOME_1000 | 0.1346 | 0.3414 | 0 | 1 |
| WH | 29.2554 | 22.7585 | 0 | 96 |
| RA | 0.3081 | 0.4618 | 0 | 1 |
| HOSP_DENS | 3.4540 | 4.9478 | 0.0113 | 33.1322 |
| PHAR_DENS | 1.9478 | 2.1558 | 0 | 14.0055 |
| HEL_HEAD | 0.3079 | 0.4617 | 0 | 1 |
| HEL_PALP | 0.1549 | 0.3619 | 0 | 1 |
| HEL_STOMACK | 0.3247 | 0.4683 | 0 | 1 |
| HEL_BACK | 0.5883 | 0.4922 | 0 | 1 |
| HEL_TIRE | 0.5581 | 0.4967 | 0 | 1 |
| HEL_COLD | 0.2122 | 0.4089 | 0 | 1 |
| HEL_SLEEP | 0.2700 | 0.4440 | 0 | 1 |
| Number of obs | 4241 | | | |

Table 3: Empirical Results

| | Without chronic conditions | | | | With chronic conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | EXP_1 | | EXP_2 | | EXP_1 | | EXP_2 | |
| | Coefficients | Margins | Coefficients | Margins | Coefficients | Margins | Coefficients | Margins |
| EXP_1 | -0.8810*** | -0.4986*** | - | - | -0.8660*** | -0.4900*** | - | - |
| | [0.2554] | [0.1435] | - | - | [0.2530] | [0.1422] | - | - |
| EXP_1*INCOME_200 | -0.6969* | -0.3943* | - | - | -0.7049* | -0.3989* | | - |
| | [0.3836] | [0.2169] | - | - | [0.3874] | [0.2191] | - | - |
| EXP_1*INCOME_400 | -0.1112 | -0.0629 | - | - | -0.1110 | -0.0628 | | - |
| | [0.2595] | [0.1468] | - | - | [0.2582] | [0.1461] | - | - |
| EXP_1*INCOME_600 | 0.1710 | 0.0968 | - | - | 0.1651 | 0.0934 | | - |
| | [0.2673] | [0.1513] | - | - | [0.2659] | [0.1505] | - | - |
| EXP_1*INCOME_800 | -0.0289 | -0.0164 | - | - | -0.0371 | -0.0210 | | - |
| | [0.2848] | [0.1612] | - | - | [0.1581] | [0.1600] | - | - |
| EXP_1*INCOME_1000 | -0.1505 | -0.0852 | - | - | 0.1396 | 0.0790 | | - |
| | [0.2951] | [0.1670] | - | - | [0.2949] | [0.1669] | - | - |
| AGE | 1.1758*** | 0.6654*** | -0.1980*** | -0.0790*** | 1.1963*** | 0.6769*** | -0.1639*** | -0.0652*** |
| | [0.1024] | [0.0585] | [0.0450] | [0.0180] | [0.1040] | [0.0593] | [0.0455] | [0.0182] |
| MALE | -0.2637 | -0.1492 | -8.5538*** | -3.4263*** | 1.0614 | 0.6001 | -7.3362*** | -2.9245*** |
| | [3.0018] | [1.6984] | [1.2650] | [0.5034] | [3.0522] | [1.7277] | [1.2750] | [0.5065] |
| HEALTH2 | 13.3361*** | 7.7849*** | 4.5738*** | 1.8956*** | 11.0251*** | 6.4027*** | 2.6991** | 1.0972** |
| | [2.8644] | [1.7164] | [1.3372] | [0.5713] | [3.0082] | [1.7889] | [1.3517] | [0.5602] |
| HEALTH3 | 21.2524*** | 12.4688*** | 4.5560*** | 1.8700*** | 17.2377*** | 10.0480*** | 1.7279 | 0.6942 |
| | [3.0553] | [1.8422] | [1.2810] | [0.5378] | [3.2385] | [1.9383] | [1.3413] | [0.5440] |
| HEALTH45 | 67.4482*** | 47.7739*** | 11.7653*** | 5.1293*** | 59.6191*** | 41.4076*** | 6.2135*** | 2.6954** |
| | [5.2470] | [4.2363] | [2.6652] | [1.1970] | [5.6087] | [4.4642] | [2.4247] | [1.1398] |
| INCOME_200 | -27.1458*** | -13.5295*** | -11.7653*** | -3.9076*** | -27.2135*** | 13.5519*** | -11.6442*** | -3.8519*** |
| | [6.7284] | [2.8969] | [2.6652] | [0.7202] | [6.7442] | [2.8977] | [2.6616] | [0.7162] |
| INCOME_400 | -15.2218*** | -8.2305*** | -7.5867*** | -2.8054*** | -15.2524*** | -8.2448*** | -7.6625*** | -2.8172*** |
| | [5.1924] | [2.6738] | [1.9230] | [0.6570] | [5.2154] | [2.6841] | [1.9101] | [0.6477] |
| INCOME_600 | -13.4940*** | -7.3735*** | -3.3938* | -1.3154* | -13.3895*** | -7.3175*** | -3.2646* | -1.2610* |
| | [5.0089] | [2.6376] | [1.8074] | [0.6797] | [5.0022] | [2.6349] | [1.7953] | [0.6735] |
| INCOME_800 | -4.4770 | -2.4986 | -2.6065 | -1.0123 | -3.9804 | -2.2248 | -2.4398 | -0.9450 |
| | [5.0569] | [2.7828] | [1.8731] | [0.7078] | [5.0614] | [2.7938] | [1.8648] | [0.7038] |
| INCOME_1000 | -9.7173* | -5.3003* | -3.1924 | -1.2234* | -9.2047* | -5.0300* | -2.9066 | -1.1128 |
| | [5.1973] | [2.7287] | [1.9891] | [0.7308] | [5.1939] | [2.7375] | [1.9763] | [0.7280] |
| EDUNIV | 11.6254*** | 6.7252*** | 6.4611*** | 2.6923*** | 11.9614*** | 6.9245*** | 6.7836*** | 2.8218*** |
| | [3.1259] | [1.8371] | [1.2907] | [0.5586] | [3.1313] | [1.8424] | [1.2865] | [0.5573] |
| EDCOL | 8.1403** | 4.7431** | 3.2931* | 1.3699* | 8.2279** | 4.7962** | 3.5078** | 1.4574** |
| | [3.8542] | [2.3056] | [1.6867] | [0.7290] | [3.8505] | [2.3052] | [1.6820] | [0.7282] |
| WH | -0.1649** | -0.0933** | 0.0273 | 0.0109 | -0.1675*** | -0.0948*** | 0.0229 | 0.0091 |
| | [0.0642] | [0.0363] | [0.0263] | [0.0109] | [0.0644] | [0.0365] | [0.0270] | [0.0107] |
| RA | -0.0761 | -0.0431 | -0.0332 | -0.0133 | -0.0750 | -0.0424 | -0.0345 | -0.0137 |
| | [0.0538] | [0.0363] | [0.0243] | [0.0097] | [0.0538] | [0.0304] | [0.0243] | [0.0097] |
| HOSP_DENS | 0.4751* | 0.2688* | - | - | 0.4688* | 0.2653* | - | - |
| | [0.2553] | [0.1444] | - | - | [0.2562] | [0.1449] | - | - |
| PHAR_DENS | - | - | 0.4894* | 0.1954* | - | - | 0.4752* | 0.1889* |
| | - | - | [0.2630] | [0.1050] | - | - | [0.2601] | [0.1034] |
| HEL_HEAD | - | - | - | - | -0.0888 | -0.0502 | 2.1570* | -0.8700* |
| | - | - | - | - | [3.0243] | [1.7108] | [1.2902] | [0.5273] |
| HEL_PALP | - | - | - | - | 2.2395 | 1.2772 | -1.6874 | -0.6571 |
| | - | - | - | - | [3.7797] | [2.1724] | [1.5699] | [0.5987] |
| HEL_STOMACH | - | - | - | - | 1.7552 | 0.9963 | 2.3547** | 0.9497** |
| | - | - | - | - | [2.8018] | [1.5958] | [1.1737] | [0.4796] |
| HEL_TIRE | - | - | - | - | -2.8585 | −1.6203 | -0.7065 | -0.2812 |
| | - | - | - | - | [2.8879] | [1.6396] | [1.2599] | [0.5023] |
| HEL_COLD | - | - | - | - | 9.9969*** | 5.8207*** | 5.8808*** | -2.4784*** |
| | - | - | - | - | [3.1001] | [1.8457] | [1.2604] | [0.5593] |
| HEL_SLEEP | - | - | - | - | 4.8808* | -2.7932* | 0.7414 | 0.2965 |
| | - | - | - | - | [2.8831] | [1.6672] | [1.2561] | [0.5054] |
| HEL_BACK | - | - | - | - | 5.9251** | -3.3349** | 3.7287*** | 1.4655*** |
| | - | - | - | - | [2.8631] | [1.6000] | [1.2499] | [0.4852] |
| CONSTANT | -40.7564*** | - | -4.3490 | - | -46.3740*** | - | -0.5328 | - |
| | [8.0809] | - | [3.4097] | - | [8.2494] | - | [3.5098] | - |
| $\sigma_1$ | 68.8149*** | | | | 68.5659*** | | | |
| | [2.0887] | | | | [2.0698] | | | |
| $\sigma_2$ | 27.8628*** | | | | 27.6926*** | | | |
| | [0.9569] | | | | [0.9489] | | | |
| $\rho$ | 0.4313*** | | | | 0.4250*** | | | |
| | [0.0314] | | | | [0.0317] | | | |
| Log Likelihood | -26296.846 | | | | -28621.045 | | | |
| $\mathcal{N}$ | 4241 | | | | | | | |
| Number of Clusters | (2766) | | | | | | | |

Notes:
(1) Standard errors are in brackets.
(2) ***,**,* indicate significance at the 1%, 5% and 10% levels, respectively.