Differentials in the Demand for Health Check-up

山田直志 (Tadashi Yamada)
山田哲司 (Tetsuji Yamada)

〔要旨〕 人が健康である場合，働く時間が増加するので労働市場における稼得能力が高まる。また，労働市場以外の生産性も高まるので家庭内生産（例えば家事，育児など）に使える時間も増加する。健康診断は，このような健康状態を維持するのに適切な方法である。この論文の目的は，わが国の20歳以上64歳以下の人々を対象に，健康診断に対する受診行動を解明することである。この分析では，性別や健康保険の種類別にみた健康診断需要の相違に注目しながら，実証分析を行った。使用したデータは『平成7年　国民生活基礎調査』のマイクロ・データであり，健康診断需要の社会・経済的要因並びに人口学的要因として取り上げた変数は，年齢，性別，所得，健康保険の種類，企業規模，職業である。実証分析の結果，これらの変数及び健康状態の指標は，個人の健康診断需要に対して統計的に有意な影響を及ぼしているが，人々の間に見られる健康診断需要に対する相違をもたらしている要因は，健康診断コストの相違であることが明らかになった。従って，健康診断を一層普及させるためには，健康診断を受けるのに必要なコストを政府が様々な方法で軽減することが求められる。そして，この目標を達成するためには，現状では健康診断を受けることが困難な面をもつ人々，すなわち既婚女性や国民健康保険加入者や中小企業の従業員などに焦点を合わせた対策が必要である。

Abstract

Good health enhances market earnings by increasing healthy days for work, and by increasing non-market productivity allows for more time available for household production. The health check-up is a good strategy to secure good health. This study aims to explain the behavior toward the demand for health check-up by the population aged 20-64 in Japan. We focus on the effects of different health insurance coverage, gender responses, with special emphasis on National Health Insurance coverage, on the demand for the health check-up. Using sample data from the *Comprehensive Survey of the Living Conditions of People on Health and Welfare* in 1995, we find a number of socio-economic and demographic factors to be the determinants of the health check-up. These determinants include : age, gender, earnings, types of health insurance coverage, firm size, occupation, and objective evaluation measures of health conditions. These variables are shown to be mostly significant in our models. Our empirical study shows that differentials in the demand for health check-up among the Japanese population aged 20-64 are mainly due to differences in the costs of accessing the health check-up. Government policies that are able to mitigate health check-up costs in various forms are highly recommended. These can be accomplished through the effective targeting of disadvantaged groups such as married women, National Health Insurance insurants and employees of relatively smaller-sized firms.

I Introduction

Good health is by itself of great value. It enhances market earnings by increasing healthy days for work (Grossman 1972), and by increasing non-market productivity, it allows for more time available for household production (Becker 1976). Health check-up is a good strategy to secure and maintain good health. However, a survey by the Japanese government, the *Comprehensive Survey of the Living Conditions of People on Health and Welfare* in 1995 (Kokumin Seikatsu Kiso Chosa, in Japanese), not only shows that about half of the population take the health check-up, but also that the demand for health check-up substantially varies among the population. The reasons behind the low demand as well as the differentials in the demand for health check-up under the comprehensive Japanese medical health care system await clarification.

Health check-up has at least two aspects. First, under uncertainty, one can likely obtain more objective diagnostic health information over subjective health evaluation. Second, the health check-up will lead to a further demand for preventive medical care when necessary. Consequently, early medical care often curtails serious illnesses. In general, individuals demand less health information when they are young, but their demand increases as age rises (Kenkel 1990). The individual's decision to take the health check-up depends on accessibility; the costs of health check-up including both the insurance coverage of the medical costs and the time costs become the major determinants of the demand for health check-up, where the latter has a larger time-price elasticity in the demand for medical inputs (Phelps and Newhouse 1974, Coffey 1983). While income has a positive effect on the demand for preventive medical care (Kenkel 1994), and better information on one's own health increases the demand for preventive medical care (Hsieh and Lin 1997), better health itself gives less incentive for individuals to collect health information. These aspects of the individual's behavior toward the demand for health check-up are due to involved uncertainty (Arrow 1963).

This study focuses on the differentials in the demand for the health check-up as differentiated by gender and by different types of health insurance. Its purpose lies in attempting to clarify the reasons behind the low demand for the health check-up among females more than males, and among persons covered by the National Health Insurance more than those covered by other types of health insurance in Japan. There had been few empirical studies, precedent to this study, which focused on this issue that uses micro-data from the *Comprehensive Survey of the Living Conditions of People on Health and Welfare* in 1995. Our study takes a sample of 449, 051 people ages 20–64 from the entire 746, 592 observations of all ages 12 and over in the Survey.[1] Based on the empirical results, we find that the gender differential in the demand for health check-up exists after controlling other socio-economic and demographic variables. Age is one other major factor that determines the demand for the health check-up. Types of health insurance coverage as well as sizes of organizations the individual works for are also robust factors that affect individual demand for the health check-up.

This paper is organized as follows. The next section provides the aspects of the health check-up based on the aforementioned survey. Section III presents our theoretical model that shows comparative static analysis of the demand for health check-up, as well as the explanation of the variables of interest in this study. We then report our empirical results in Section IV and our summary in Section V.

II Aspects of the Health Check-up

Japan's Medical Insurance System is a comprehensive system covering the entire population through the National Health Insurance, the

Employees' Health Insurance, and the Seamen's Insurance.[2] Of the Employees' Health Insurance, there are three types : (1) the Society-managed Health Insurance, provided for by an employer with 700 employees or more,[3] (2) the Health Insurance managed by the Government, provided for by an employer with less than 700 employees, and (3) the Mutual Aid Associations Health Insurance covering public employees, and teachers and personnel of private schools. The medical care benefits under the Employees' Health Insurance cover 80 percent and 70 percent of medical costs for insured persons and their dependents, respectively. The National Health Insurance is a community-based insurance plan for local residents who are not covered by the Employees' Health Insurance. It pays for 70 percent of the medical costs incurred by all insured persons.[4]

Of the various health check-ups provided by firms, there are three classifications : the compulsory health check-up instituted by law, the recommended health check-up, and the discretionary ones in the firms. The general health check-up is usually compulsory prior to the commencement of employment, and then again once every year throughout the duration of employment. It includes the following items : (1) report of medical history, (2) self-evaluation and objective evaluation of medical symptoms, (3) height, weight, optesthesia, color vision (chromatopsia), and audiometry, (4) chest X-ray radiography, (5) blood pressure, (6) urine examination, (7) anemia, (8) liver function, (9) blood lipids, (10) blood sugar, and (11) electrocardiogram.

Besides these various health check-ups, firms often provide their employees another type of health check-up as a fringe benefit : half day, one-day or two-day thorough health check-up in hospital once a year in order to find the employee's sickness at an early stage as well as to promote the employees' health condition.[5] This type of medical service for employees, called "*Nin-gen* Dock (in Japanese)", is not covered by the Employees' Health Insurance. According to *The Situations of Fringe Benefits* (Fukuri Kosei Jizyo, in Japanese : Institute of Labor Administration, 1998), about 81 percent of the surveyed 5,000 firms, sampled from across the industries, subsidize about 70 percent or more of the incurred medical costs of the comprehensive health check up in hospital.[6] The average amount of the coverage is about $ 350, within the range of $ 100 to $ 900.[7] About 89 percent of the firms with 3,000 employees or more provide this subsidy, about 84 percent of those with 1,000–2,999 employees, and about 74 percent of those with less than 1,000 employees.

In a similar way, the National Health Insurance also provides for various types of health check-up to local residents who are not covered by the Employees' Health Insurance and other types of health insurance.[8] Generally, the local government notifies their residents about the schedules for the health check-up. These health check-up periods are scattered throughout the year in order to avoid the busy periods for their residents, e. g., farmers. Residents usually go to one of the health centers within the vicinity for their health check-up but go to hospitals and clinics for certain types of medical check-ups. They pay the minimum fee according to the type of health check-up they take.

The types of health check-up provided by local governments are as follows : (1) group health check-up at local health centers and individual visits to hospitals or clinics,[9] and (2) comprehensive medical health check-up in hospitals, i.e., the "*Nin-gen* Dock". The former includes the basic health check-up items mentioned earlier for a fee of about $ 10, and tests for the following : gastric cancer ($ 8), carcinoma of the colon and rectum ($ 5), lung cancer (no fee ; $ 5 for examination of sputum) , tuberculosis (no fee), carcinoma cancer uteri ($ 6), osteoporosis ($ 5), breast cancer ($ 10), and other types of women's medical tests ($ 5). The latter is inclusive of the basic health check-up items plus other services depending on the length of hospital stay. The subsidies by local

governments are, for example, $175 for general medical examination (own out-of-pocket expenses are about $190; that is, the total costs are about $365), $250 for brain examination (own expenses are about $274), and $375 for comprehensive examination, i. e., general plus brain examinations, (private expenses amount to about $410). The provisions for the above-mentioned health check-up have age restrictions, such as the general medical examination for people aged 30 or more, and the brain and comprehensive examinations for those aged 40 or more.

Now, we will report on how people aged 20 to 64 in Japan have the health check-up, based on the *Comprehensive Survey of the Living Conditions of People on Health and Welfare* in 1995 ("Kokumin Seikatsu Kiso Chosa" in Japanese; hereafter the Survey). Of people aged 20-64 in the Survey, the sample sizes are: overall N=449,051, male N=219,983, and female N=229,068. The overall average of the health check-up is 0.557, that is, 55.7 percent of the population has had the health check-up (see Table 1). The proportion of males taking the health check-up is 0.607, which is about 10 percentage points above the 0.509 of females. Let us now refer to the sample means of the proportion of people having their health check-up by different types of health insurance and different age groups. We show the averages for each type of insurance cover for each age group in Table 1 and Figure 1. We note that the health check-up proportion is highest (0.692) for Mutual Aid Associations Health Insurance (MUTUHI, i.e., public employees, and teachers and personnel of private schools) in almost all of the different age groups, and second highest (0.647) for Society-managed Health Insurance (SOCIHI, i.e., 700 employees or more in a firm).[10] Meanwhile, National Health Insurance (NHI) insurants have the lowest proportion of health check-up takers (0.419). For example, the difference in the health check-up rate between males with the National Health Insurance and those with the Mutual Aid Associations Health Insurance is nearly 40 percent-

Table 1 Health Check-up Rate by Health Insurance Type for both Males and Females

	Years Old	20～64	20～29	30～39	40～49	50～60	61～64
Overall Number	n=449,051	**0.557**	**0.457**	**0.521**	**0.597**	**0.620**	**0.585**
MALES	n_{male}=219,983	0.607	0.487	0.630	0.652	0.653	0.583
FEMALES	n_{female}=229,068	0.509	0.429	0.415	0.543	0.590	0.587
National Health Insurance		**0.419**	**0.269**	**0.311**	**0.396**	**0.490**	**0.550**
MALES	n_{male}=67,320	0.409	0.286	0.346	0.397	0.458	0.523
FEMALES	n_{female}=74,104	0.429	0.252	0.278	0.396	0.517	0.573
Government-Managed Insurance		**0.582**	**0.474**	**0.532**	**0.630**	**0.668**	**0.654**
MALES	n_{male}=69,743	0.635	0.504	0.633	0.682	0.705	0.684
FEMALES	n_{female}=75,709	0.535	0.448	0.438	0.584	0.635	0.623
Society-Managed Insurance		**0.647**	**0.550**	**0.610**	**0.704**	**0.733**	**0.666**
MALES	n_{male}=55,112	0.739	0.590	0.763	0.809	0.808	0.715
FEMALES	n_{female}=51,481	0.549	0.510	0.455	0.595	0.644	0.612
Mutual Aid Associations Insurance		**0.692**	**0.563**	**0.648**	**0.755**	**0.775**	**0.690**
MALES	n_{male}=24,797	0.789	0.598	0.808	0.848	0.841	0.709
FEMALES	n_{female}=25,183	0.598	0.534	0.503	0.662	0.697	0.675

Note: The overall number includes people with Seamen's Health Insurance (n=5,602).

age points ; the former is 0.409 and the latter is 0.789. For females in the same two categories, the differential becomes somewhat smaller : 0.429 for females with the National Health Insurance, and 0.598 for their counterparts with Mutual Aid Associations Health Insurance.

A reason for the high health check-up rates for employees covered by either MUTUHI or SOCIHI is that they enjoy better and more fringe benefits, and with easier access to the health check-up, they incur lesser costs. In fact, firms with 1,000 or more employees, by law, must have their industrial doctor and medical assistance such as nurses in their work places. On the other hand, smaller firms may provide less medical facilities and services at their working sites, and sometimes they may not want employees to leave their jobs simply for the health check-up. In response to this problem, branches of the Supervision of Labor Standards often facilitate informing the employers, as well as providing on-site health check-up by parking medical vehicles with X-ray radiation equipment near or at their work sites. Also, people with the National Health Insurance have less accessibility to health check-up facilities compared to those working at large firms even if both groups are notified regarding the health check-up days and places by local governments. As observed in Table 1 and Figure 1, we notice that there are variations in the health check-up rates among different health insurance coverages as well as among different age groups of each health insurance. The apparent reason that people of older age groups have higher health check-up rate is their higher risk of sickness as compared with younger age groups. Thus, these differences in health check-up rate by the type of health insurance and by the age factor must be underlined.

Now, we examine in detail the health check-up rate of females. Except for those with the National Health Insurance, females have a similar pattern of the health check-up rate with regard to each other, as shown in Figure 1. Their health check-up rates dip at the age of 30–34 years old.[11] This reduction in the health check-up rate probably reflects the timing of marriage and the delivery of a child.

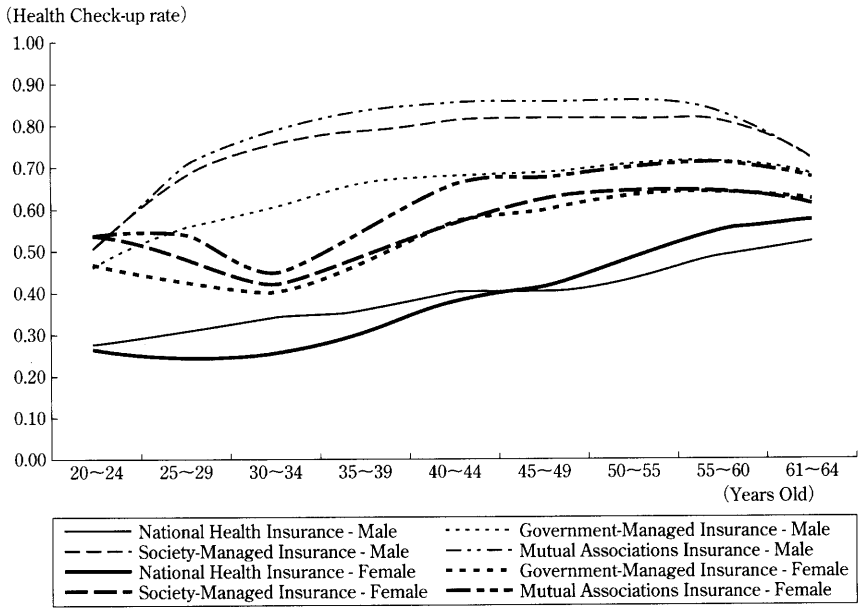

Figure 1 Health Check-up Rate by Health Insurance Type

During pregnancy, these women meet doctors on a regular basis so they are likely to be well informed regarding their health conditions and do not necessarily need to take their health check-up. Furthermore, they are likely to be advised not to take X-ray during the period of maternity. Although we do not see any dip in the health check-up rate of females with the National Health Insurance, the average rate for those aged 30-39 is far lower (0.278) than those covered by other types of health insurance. Thus, we observe there exist variations in the opportunities for health check-up for different health insurance types, gender, and age groups. The low health check-up rate of females aged 30-39 very likely reflects the risk of maternity.

Concerning the difference in health check-up rate between married and single women (not shown in the Table for brevity), first we note that the rate among women is generally lower for married than for single women in all types of health insurance except for women insurants under the National Health Insurance. For example, the health check-up rates for married women aged 30-39 are 0.277 (NHI), 0.409 (Government-managed Health Insurance : GOVTHI), 0.419 (SOCIHI) and 0.479 (MUTUHI), whereas the respective rates for single women are 0.280, 0.588, 0.712, and 0.731. Second, the difference in health check-up rate between married and single women under a given health insurance narrows at the ages of 61-64. The health check-up rates of married and single women for the 61-64 age are, respectively, 0.585 and 0.530 under NHI, 0.625 and 0.619 under GOVTHI, 0.614 and 0.607 under SOCIHI, and 0.696 and 0.626 under MUTUHI. Third, concerning males, the health check-up rate is always higher for married than for single men. The fear of losing their income due to illness seems to be giving strong incentives for married men to have their health check-up.

An explanation for the higher health check-up rates among single women is probably due to a larger loss in income should they become ill and have no one to ask for help.[12] On the other hand, the generally low health check-up rates for married women can be partially explained by the following reasons. First, as mentioned previously, married women aged 20 to 39 have a high risk of damaging the fetus by having X-ray during the pregnancy period. Second, married women with young children and those living with their parents face higher opportunity costs of having their health check-up unless they get supportive assistance for household work when they visit clinics and hospitals. Finally, the reason why the health check-up rates are similar among different types of health insurance, but where the check-up rate lowers at the ages of 61-64, can be attributed to the retirement age. That is to say, most women are already retired from employment.

Finally, we will examine the attitude of people with National Health Insurance by employment status because these NHI insurants have the lowest rates of the health check-up. We have argued earlier that people having greater accessibility to health check-up facilities are more likely to take their health check-up than otherwise. If this hypothesis is correct, people with the same National Health Insurance but have different employment settings will have different health check-up rates. For example, those with National Health Insurance but employed at large-sized firms (e.g. those with over 1,000 workers) should have higher health check-up rates compared to those working at a relatively small-sized firm with less than 30 workers.[13] The over-all health check-up rate from ages 20 to 64 is 0.343 for female insurants of the National Health Insurance but working at a firm with 1 to 4 workers, while the rate (0.624) is highest for those working at a firm with over 1,000 workers. The respective rates for working male insurants of the National Health Insurance are 0.331 at a firm with 1 to 4 workers and 0.784 at a firm with over 1,000 workers. The low rate of health check-up among people working

at a firm with 1-4 workers reflects that smaller firms provide less medical facilities and services at their work sites than larger firms and sometime the former may not want employees to leave their jobs simply for the health check-up. Of household workers who have the National Health Insurance, they have one of the lowest health check-up rates among the various categories of employment: 0.393 for NHI female and 0.383 for NHI male. Additional evidence is also seen in related household-categories, such as the self-employed, family workers, etc.

For this section, what we have learned from the sample of approximately 450,000 people, aged 20 to 64, obtained from the *Comprehensive Survey of the Living Conditions of People on Health and Welfare* in 1995 may be summarized as follows.

(1) As people grow older, they are more likely to take the health check-up.

(2) People with National Health Insurance are less likely to take the health check-up than those covered by either Society-managed Health Insurance or Mutual Aid Associations Health Insurance.

(3) Males and females have distinctly different attitudes toward the health check-up.

(4) Single women are more likely to take the health check-up than married ones; for the males, the opposite is true.

(5) Among people with National Health Insurance, those employed by larger-sized firms have the health check-up more than those employed at home and in smaller-sized firms.

We shall try to incorporate these observations into our theoretical model and to clarify the factors that contribute to the low health check-up rate of insurants under the National Health Insurance, which has the lowest health check-up rate among the different health insurances.

III Theoretical Model

1 Model

As was mentioned in the previous section, the average proportion of 20 to 64 year-old Japanese, who had the health check-up in 1995, is about 56 percent. Nearly half of the population did not take their health check-up despite the fact that the purpose of the health check-up is to provide information on the individual's health status by identifying symptoms and illnesses at their early stages.

There are a number of possible explanations as to why people do not take the health check-up. One of the possible reasons could be that most people are risk-lovers, but this is hardly an acceptable explanation. Or that, on the contrary, most people are risk-averse but they feel they have adequate knowledge of their health condition; thus, the marginal benefits of having the health check-up are too little relative to its costs. There are many other explanations that are possible but too many to be mentioned. However, irrespective of the reasons, people are faced with the uncertainty problem of the incidence of an illness. Generally, a person could prevent future financial losses and psychological burdens by having more and better information with regard to her present health condition. This kind of information could be provided by the health check-up.

In this section, we would like to show an application of the theory of insurance under uncertainty. This aims to explain the individual's choice on whether to have or not to have the health check-up in response to the exogenous changes the individual is faced with.

Let us assume that an individual's preferences can be represented by a utility function,

$$U = U(S_1, S_2; \pi_1, \pi_2). \qquad (1)$$

Here, utility is defined over the contingent earning capacity (S_1, S_2).[14] The corresponding probabilities π_1, π_2 are parameters of the utility function, since the value of a state-contingent earning capacity depends on how likely the state is to occur.

Suppose there is an event S_1, where an individual is faced with probability π_1: she maintains her initial health-related endowment S_0 by incurring the cost $(P+C)$ per unit of health check-up h;[15] P is the price of health check-up per unit; and C is pecuniary as well as non-pecuniary costs other than P of health check-up. P differs according to the individual's health insurance. Then, S_1 is defined as,

$$S_1 = S_0 - (P+C)\ h. \qquad (2)$$

In the second event S_2, the individual is now faced with the probability π_2: she suffers loss L of her earning capacity. We assume further that the value of loss increases as her age A progresses. That is, the individual's opportunity costs rise (at a diminishing rate) as age does.[16] Her stock of health eventually depreciates as age increases. Also, we assume an additional factor in the argument of loss L: the individual may take some health promoting activities H to increase her health stock HS. Loss L is defined as follows:

$$L = L\ (A, H),$$
$$\frac{\partial L}{\partial A} > 0 \text{ and } \frac{\partial L}{\partial H} = \frac{\partial L}{\partial HS}\frac{\partial HS}{\partial H} > 0. \qquad (3)$$

In equation (3), the size of loss L depends on types of illnesses.[17] Different illnesses show different measurable symptoms (although some show similarities) such as high blood pressure, high cholesterol, proteinuria, and high white blood cell. Each symptom s_j is associated with a particular illness and, hence, with a particular loss L_j. Having the health check-up is influenced by subjective and/or objective symptoms such that,

$$h = h\ (s_j), \quad j = 1, \cdots, n. \qquad (4)$$

If symptoms are subject to a probability distribution such as $\pi_j\ (s_j)$, we can assume that having the health check-up is an inverse function of symptoms,

$$\pi_j^{-1}\ (h) = (s_j). \qquad (5)$$

Therefore, we can show the relationship between health check-up h and loss L_j as,

$$\pi_j^*(h)\ L_j, \qquad (6)$$

where π_j^* is probability associated with loss L_j. The expected loss due to illness can be expressed as,

$$\text{Expected Loss} = \pi^*\ (h)\ L\ (A, H) = \sum_{j=1}^{n} \pi_j^*\ (h)\ L_j\ (A, H). \qquad (7)$$

Finally, if event 2 occurs, the individual receives medical care, which can be considered as earning-capacity-augmenting benefits M. However, the individual may not be able to receive benefits without some negative aspects. That is, during the interim when she is sick and is treated by a medical doctor, she visits the clinic or hospital; she waits for her turn with fatigue.[18] The psychological burden should be considered in the calculation of costs such that $-gM$, where $0 < g < 1$. Now, we define event 2 in terms of loss and benefits in money-equivalent units,

$$S_2 = S_0 - (P+C)\ h - \pi^*\ (h)\ L\ (A, H) + (1-g)\ M, \qquad (8)$$

Finally, concerning the probabilities attached to events 1 and 2, π_1 and π_2 are functions of an individual's age A. In other words, as she becomes older, say in her 50s as compared to her 20s or 30s, she becomes more contingent to illness. We express the individual's preference for an uncertain prospect in the form of an expected utility function, a Von Neumann-Morgenstern utility function, as follows:[19]

$$EU = (1-\pi\ (A))\ U\ (S_0 - (P+C)\ h) + \pi\ (A)\ U\ (S_0 - (P+C)\ h - \pi^*\ (h)\ L\ (A, H) + (1-g)\ M) \qquad (9)$$

The value of h that maximizes EU satisfies the following first-order condition:

$$(1-\pi\ (A))\ U_x\ (x)\ (P+C) + \pi\ (A)\ U_y\ (y)\ [\ (P+C) + \pi_h^* L\ (A, H)\ ] = 0, \text{ at } h > 0, \qquad (10)$$

$$-\frac{(P+C) + \pi_h^* L\ (A, H)}{(P+C)} = \frac{(1-\pi\ (A))\ U_x\ (x)}{\pi\ (A)\ U_y\ (y)}, \qquad (11)$$

$$x \equiv S_0 - (P+C)\ h,$$

$$y \equiv S_0 - (P+C)\, h - \pi^*(h)\, L(A, H) + (1-g)\, M,$$

$$U_x = \frac{\partial U}{\partial x} > 0,$$

$$U_y = \frac{\partial U}{\partial y} > 0, \text{ and}$$

$$\pi_h^* = \frac{\partial \pi^*(h)}{\partial h} < 0.$$

In equation (11), the left-side expression is interpreted as the marginal productivity of health check-up and the right-side one is the slope of the indifference curve (Ehrlich and Becker 1972, p. 634).[20] The equilibrium condition requires $(P+C) + \pi_h^* L(A, H) < 0$. That is, an additional dollar spent on health check-up must reduce the expected loss by more than a dollar.[21] In other words, if an individual does not expect the benefits from the reduction of her expected loss to be greater than the health check-up cost, she will not take the health check-up. Putting it differently, based on equation (10), if the maximum of EU occurs when $h=0$, rather than $h>0$, then necessarily $EU' \leq 0$; hence, we will have a corner solution. Furthermore, even if $h>0$ to start with, there may be some range of EU, where $EU' \leq 0$. This may be the case when $-1 \leq [\pi_h^* L(A, H) / (P+C)] \leq 0$. Then, the individual will not have her health check-up, hence, $h=0$ at which $EU(h=0) > EU(h>0)$. For example, when the individual already has adequately good information on her current health condition, it does not make any sense for her to see a medical doctor in hospital for a slight cough.

The second-order condition of equation (10) requires,

$$D = (1-\pi(A))\, U_{xx} (P+C)^2 + \pi(A)\, U_{yy} \Phi^2 < 0, \qquad (12)$$

$$U_{xx} = \frac{\partial U_x}{\partial x} < 0,$$

$$U_{yy} = \frac{\partial U_y}{\partial y} < 0,$$

$$\frac{\partial \pi_h^*}{\partial h} \equiv \frac{\partial^2 \pi^*(h)}{\partial h^2} = 0$$

(assumed without loss), and

$$\Phi = [(P+C) + \pi_h^* L(A, H)] < 0.$$

We can now find the effect of an individual's age A on the demand for the health check-up h by partially differentiating the first-order optimality condition, equation (10), with respect to A:

$$\frac{\partial h}{\partial A} = \frac{1}{D}[\pi_A (-U_x (P+C) + U_y \Phi) + \pi(A)\, L_A (U_y \pi_h^* - U_{yy} \pi^*(h)\, \Phi)] > 0 \qquad (13)$$

where

$$\pi_A \equiv \frac{\partial \pi(A)}{\partial A} > 0, \text{ and}$$

$$L_A \equiv \frac{\partial L(A, H)}{\partial A} > 0.$$

The above positive sign shows that, as an individual grows older, she is more likely to have her health check-up.

Let us now consider the case of an increase in the price P of health check-up. That is, the coverage of medical costs by health insurance decreases in clinics and hospitals. The effect of an increase in P on the health check-up is negative as the following shows:

$$\frac{\partial h}{\partial P} = \frac{1}{D}[(1-\pi(A))\, U_{xx}(-h)(P+C) + \pi(A)\, U_{yy}(-h)\, \Phi + (1-\pi(A))\, U_x + \pi(A)\, U_y]. \qquad (14)$$

$\frac{\partial h}{\partial P} < 0$ is guaranteed if $(1-\pi(A))\, U_{xx}(P+C) + \pi(A)\, U_{yy} \Phi < 0$.[22]

In other words, as the coverage of medical costs by health insurance increases, i.e., a decrease in P, an individual is more likely to have her health check-up. Then, if the above condition is satisfied, then we can also say that an increase in pecuniary and non-pecuniary costs, C, will give a disincentive for an individual to have her health check-up. For example, in the case of a pregnant woman, having chest X-ray radiography by her health check-up is likely to damage her fetus. Thus, she is very unlikely to have her health check-up during the period of pregnancy.

The effect of an increase in an individual's initial

endowment S_0 may be found to be positive as,

$$\frac{\partial h}{\partial S_0}=\frac{1}{D}[\ (1-\pi\ (A))\ U_{xx}\ (P+C) + \pi\ (A)\ U_{yy}\Phi]>0. \qquad (15)$$

This result (15) shows that an individual with higher earning power, for instance, one with a larger stock of human capital, is willing to have the health check-up to secure her earnings loss.

Here, let us see whether an individual who is willing to have health stock augmenting activities will have her health check-up or not. By partially differentiating the first-order optimal condition, we have the following result :

$$\frac{\partial h}{\partial H}=\frac{1}{D}[\pi\ (A)\ L_H\ (\pi_h^* U_y - \pi^*\ (h)\ U_{yy}\Phi)\ ]>0, \qquad (16)$$

$$L_H=\frac{\partial L\ (A, H)}{\partial H}>0.$$

Hence, an increase in health stock augmenting activities, which raises earning capacities through an increase in the individual's health stock, will tend to encourage the individual to have the health check-up in order to avoid the earnings loss due to sudden illness.

We can also evaluate the effect of the psychological burden g in terms of $(1-g)\ M$ in equation (9), which is a burden incurred by an individual due to her illness. When an individual is sick and has to wait many hours at a busy hospital, this creates for her psychological costs, e. g., fatigue. In case of heavy illness, she may have to be hospitalized for cure with medical treatments that may take several hours or days. The effect of an increase in g on h will be positive,

$$\frac{\partial h}{\partial g}=\frac{1}{D}[-\pi\ (A)\ U_{yy}\Phi M]>0. \qquad (17)$$

The above result can be interpreted as : when an individual believes she may be more prone to some serious illness, say, through her job, she is more willing to have her health check-up in order to avoid greater psychological burden should she become ill. On the other hand, the effect of an increase in the medical benefits M on health check-up is negative,

$$\frac{\partial h}{\partial M}=\frac{1}{D}[\pi\ (A)\ U_{yy}\Phi\ (1-g)\ ]<0. \qquad (18)$$

Hence, the individual becomes less self-protective as benefits increase, which is an aspect of the moral hazard present.

Finally, we will discuss the effect of gender difference on the health check-up. In the formulation of equation (7), the expected loss, $\pi^*\ (h)\ L\ (A, H)$, can be defined as,

$$\overline{L^f}=\pi^f\ (h)\ L^f\ (A, H) \text{ or}$$
$$\overline{L^m}=\pi^m\ (h)\ L^m\ (A, H), \qquad (19)$$

where $\overline{L^i}$ is a gender-specific expected earning loss, $(i=f, m)$: $f=female$, and $m=male$. $\overline{L^i}$ is a positive function of both $\pi^i\ (h)$ and $L^i\ (A, H)$ such as,

$$\frac{\partial \overline{L^i}}{\partial \pi^i\ (h)}>0, \text{ and } \frac{\partial \overline{L^i}}{\partial L^i\ (A, H)}>0.$$

The effect of an increase (or a shift) in the probability distribution on the health check-up is found to be,

$$\frac{\partial h}{\partial \pi^i\ (h)}=\frac{1}{D}[-\pi\ (A)\ U_{yy}\ L^i\ (A, H)\ \Phi^i]>0, \qquad (20)$$

where $\Phi^i=\ (P+C)\ +\pi_h^* L^i\ (A, H)\ <0$, following the assumption, $\frac{\partial \pi_h^*}{\partial \pi^i\ (h)}=0$. This result indicates that individuals who are more prone to illness are more likely to have the health check-up than those who are not. This positive relationship can also be applied to $\overline{L^i}$; that is, $\frac{\partial h}{\partial \overline{L^i}}>0$. That is, an individual with higher expected loss is more likely to have her health check-up than one with less. Therefore, when both female and male are in the labor market and the former earns less than the latter such as $L^f\ (A, H)\ <L^m\ (A, H)$, females are less likely to have the health check-up than males do since $\pi^f\ (h)\ <\pi^m\ (h)$ in general. The same applies to equally healthy females for a female who earns more. This indicates that a single woman in the labor market is more likely to have her health check-up than a married woman in the

household when both are equally healthy. We may also say that if a married woman were to have some interruption in her career, a single woman is more likely to have her health check-up than a married woman even although both are currently in the labor market and are equally healthy.

All these comparative static results must then be evaluated and be operational in an empirical study. For our empirical specifications, we suppose that the decision of an individual to have the health check-up or not depends on an unobservable utility index I_i, defined as,

$$I_i = X\beta + u_i, \qquad (21)$$

X : a $(1xk)$ row vector of explanatory variables that determines I_i,

β : a $(kx1)$ column vector of parameters to estimate, and

u_i : a normally distributed random term.

In equation (21), the larger the value of the index I_i, the greater the probability of the individual to have the health check-up. Here, we assume that for the individual there is a critical level of the index I_i^*, such that if I_i exceeds I_i^*, she will have health check-up, otherwise she will not. To put it differently, in terms of the notations in our comparative static analyses, $\Phi = [\ (P+C) + \pi_h^* L\ (A, H)\ ] < 0$ and $\frac{\partial EU}{\partial h} = 0$ at $h > 0$ imply $I_i - I_i^* \geq 0$. Therefore, let $h = 1$ if the individual has the health check-up, and $h = 0$ if he does not. Since I_i, I_i^*,and Φ are not observable, if we assume I_i and I_i^* to be normally distributed with the same mean and variance, the probability that the individual has the health check-up may be expressed as,

$$\begin{aligned} \text{Prob}\ (h=1) &= \text{Prob}\ (I_i^* \leq I_i) \\ &= F\ (I_i) \\ &= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{X\beta} e^{-t/2} dt, \qquad (22) \end{aligned}$$

where $F\ (\cdot)$ is the cumulative distribution function, and t is a standardized normal variable, i.e., $t \sim N\ (0, 1)$.[23] We estimate a probit model of the demand for the health check-up. The next section mentions variables of interest in this study.

2 Variables

We show the comparative static analyses of the effects of variables of interest on the demand for the health check-up with the previous theoretical model described. The dependent variable used in this study is whether individuals have the health check-up or not, thus, we use a dummy variable $(=1)$ if the individual has her health check-up, otherwise, the value is 0.[24]

One of the major explanatory variables to explain the variation in the demand for medical health check-up is the age of individuals. Its relationship is theoretically positive. The relationship between age and the medical health check-up observed from our sample is slowly increasing at a diminishing rate until the age of 60 and then declines. The reason for this decline in the demand for medical health check-up is the retirement age at 60 years old for those working in relatively large-sized firms. It needs to be mentioned here that persons who retire are still eligible for a type of health insurance that is part Society-managed Insurance or Government-managed Insurance for the two years following the retirement. Otherwise, these individuals may choose the National Health Insurance coverage.

Gender is another major explanatory variable in this analysis, such that the males' health check-up rate always exceeds the females' across the 20–64-age range. The differentials in their health check-up rates certainly result from their biological differences such that males are more prone to illness or have shorter life longevity than females. We have theoretically shown that males are more likely to have their health check-ups than females due to the higher expected loss for the former than the latter. We will examine the effect of gender difference on the demand for health check-up, *ceteris paribus*.

Besides the effects of the above demographic variables, the explanatory variable that can be considered as a policy-implication variable is health insurance coverage. This includes the National

Health Insurance (NHI), Government-managed Health Insurance (GOVTHI), Society-managed Health Insurance (SOCIHI), and Mutual Aid Association Health Insurance (MUTUHI). The NHI coverage rate is 70% for everyone, while the coverage rates of other three types of insurance are 80 percent (the coverage rate for spouse and family is 70 percent).

To examine the effect of an individual's initial endowment on health check-up, we use the dummy variable for the household's highest income earner (i.e., breadwinner). In addition, we include the household's monthly expenditures, which will have the income effect on the demand for the health check-up. When monthly expenditures are not reported, we use a dummy variable for the individual who did not report the values, since the regression results may be biased if we exclude all who did not report this for the study.

For the measurement of health stock augmenting activities by individuals, we use the frequency of daily practices such as eating regular meals, nutritiously balanced meals and not-too-salty meals, not eating excessively, having physical exercise, adequate hours of sleep, and time to refresh oneself during the activities of the day. We expect that the effect of this variable on the demand for health check-up is positive, shown previously to be theoretically positive.

To evaluate the effect of the psychological burden when the individual becomes ill and also to evaluate the behavior of individuals who are more prone to illness, the numbers of illnesses the individual has had is included as an explanatory variable. This variable is also shown to be theoretically positive. This number includes diseases of the circulatory system, respiratory system, digestive system, genitourinary system, and so forth. Although the illnesses of each system can be explanatory variables in our regression, we decided not to use this approach because of the difficulty in evaluating the differences of their effects, besides the numbers are too many to be meaningful for our interest. In addition to the illness variable, we also include the number of stressful events the individual has had to face. These three explanatory variables are considered as objective variables in evaluating the individual's health condition. To avoid specification errors, the subjective evaluation of an individual's health condition is also included in the regression analysis. In doing so, we use three dummies to represent this : excellent health if one feels his health to be excellent, good health when he considers it good, and fair health if he feels he possesses fair health conditions.

As for the effect of the medical benefits on the demand for health check-up, we use the variable on life insurance as proxy for benefits. The effect of this variable is expected to be negative on the health check-up. There are various types of life insurance sold these days. Some provide coverage only for costs incurred upon hospitalization and for injuries.

To examine the effect of a change in the likelihood of illness on health check-up, we use a dummy variable for the individual whether he has visited either clinics or hospitals for the past year. If the individual did not visit those institutions at all for one year, we consider the individual healthy, *ceteris paribus*. Thus, her tendency to become ill is smaller than a counterpart who had been to either a clinic or hospital more often.

Other than these explanatory variables mentioned above, we include the variables on education, sizes of firms, types of employment, sizes of population, and regional dummies. The definition and statistics of the variables used in this study are reported in Table 2.[25] In the next section, we will report our empirical results.

IV Empirical Results

Results for the probit analyses regarding the demand for the health check-up are reported in Table 3 for both males and females of the 20-64 age range. Table 4 shows the results for popula-

Table 2 Description of Variables and Gender-Specific Statistics of Sample Used in the Study

Variables	Description	Males Sample n=214,948 Mean	Std. Dev.	Females Sample n=223,958 Mean	Std. Dev.
HCHECKUP	If the individual has health check-up, HCHECKUP=1 ; otherwise=0.	0.607	0.488	0.509	0.500
AGE	Age	42.22	12.69	42.41	12.78
AGESQ	Age squared.	1943.19	1070.22	1961.80	1082.10
MATERNITY	If the female observation's age falls within the average maternity age group 30-39, MATERNITY=1 ; otherwise=0.	—	—	0.203	0.402
MARRIED	If the individual is married, MARRIED=1 ; otherwise=0.	0.714	0.452	0.731	0.444
WAGE	Wage rate per hour (in 1,000 Yen)[a]	1.796	0.430	1.196	0.224
BREADWIN	If the individual is the highest income earner in the household, BREADWIN=1 ; otherwise=0.	0.753	0.431	0.135	0.342
MONTHEXP	Monthly expenditures (in 10,000 yen)	28.77	38.21	29.04	37.99
MOEXPDUM	If monthly expenditures are not reported, MOEXPDUM=1 ; otherwise=0.	0.063	0.242	0.061	0.238
NHI	If the individual has National Health Insurance, NHI=1, otherwise=0.	0.306	0.461	0.324	0.468
GOVTHI	If the individual has Health Insurance managed by Government, GOVTHI=1 ; otherwise=0.	0.317	0.465	0.331	0.470
SOCIHI	If the individual has Health Insurance managed by Associations, SOCIHI=1 ; otherwise=0.	0.250	0.433	0.225	0.417
MUTUHI	If the individual has Mutual Aid Associations Insurance, MUTUHI=1 ; otherwise=0.	0.113	0.316	0.110	0.313
PROPRIET	If the individual works as a proprietor, or self-employed, PROPRIET=1 ; otherwise=0.	0.155	0.362	0.035	0.183
FAMILYWK	If the individual works for a family-owned business, FAMILYWK=1 ; otherwise=0.	0.024	0.154	0.075	0.263
SIZE1	If the individual is an employee of a firm with 1-4 employees, SIZE1=1 ; otherwise=0.	0.026	0.159	0.023	0.150
SIZE5	If the individual is an employee of a firm with 5-29 employees, SIZE5=1 ; otherwise=0.	0.132	0.339	0.096	0.295
SIZE30	If the individual is an emloyee of a firm with 30-99 employees, SIZE30=1 ; otherwise=0.	0.120	0.325	0.082	0.274
SIZE100	If the individual is an employee of a firm with 100-499 employees, SIZE100=1 ; otherwise=0.	0.117	0.322	0.070	0.254
SIZE500	If the individual is an employee of a firm with 500-999 employees, SIZE500=1 ; otherwise=0.	0.041	0.197	0.018	0.133
SIZE1000	If the individual is an employee of a firm with 1,000 or more employees, SIZE1000=1 ; otherwise=0.	0.123	0.329	0.040	0.195

PUBEMPLY	If the individual is a public employee, PUBEMPLY=1 ; otherwise=0.	0.081	0.272	0.038	0.190
PARTTIME	If the individual works part time, PARTTIME=1 ; otherwise=0.	0.016	0.124	0.043	0.203
HUSWRKR	If the individual is a home-based employee, HUSWRKR=1 ; otherwise=0.	0.009	0.092	0.026	0.159
NOJOB	If the individual is not working, NOJOB=1 ; otherwise=0.	0.103	0.304	0.440	0.496
PROFES	If the individual is a professional such as engineer, PROFES=1 ; otherwise=0.	0.142	0.349	0.082	0.274
ADMINI	If the individual is an administrator, ADMINI=1 ; otherwise=0.	0.081	0.272	0.015	0.123
CLERIC	If the individual is a clerk, CLERIC=1 ; otherwise=0.	0.111	0.314	0.136	0.343
SALES	If the individual is a sales person, SALES=1 ; otherwise=0.	0.088	0.283	0.075	0.263
SERVIC	If the individual is an employee of the service industry, SERVIC=1 ; otherwise=0.	0.064	0.244	0.082	0.274
AGRICU	If the individual works in the agricultural sector, AGRICU=1 ; otherwise=0.	0.036	0.186	0.027	0.162
FOREST	If the individual works in the forestry sector, FOREST=1 ; otherwise=0.	0.003	0.050	0.001	0.030
FISHER	If the individual works in the fishery sector, FISHER=1 ; otherwise=0.	0.008	0.087	0.002	0.049
TRANSP	If the individual is an employee of the transportation industry, TRANSP=1 ; otherwise=0.	0.046	0.210	0.003	0.054
CRAFTM	If the individual works in the crafts-making industry, CRAFTM=1 ; otherwise=0.	0.265	0.441	0.106	0.308
DOCTOR	The number of physicians per 100,000 population in a prefecture.	186.58	35.99	187.47	35.66
SICKNUMB	The number of injuries and illnesses.	0.323	0.739	0.407	0.838
STRESS	The number of stressful events had been/being experienced.	0.815	1.437	1.069	1.653
NOTVISIT	If the individual did not visit medical institutions for the past year, NOTVISIT=1 ; otherwise=0.	0.077	0.267	0.091	0.287
HLTHPRAC	The number of health-related daily practices.	2.348	1.909	2.659	1.882
HLTHEXCE	Self-evaluation of the individual's health : if excellent, HLTHEXCE=1 ; otherwise=0.	0.338	0.473	0.295	0.456
HLTHGOOD	Self-evaluation of the individual's health : if good HLTHGOOD=1 ; otherwise=0.	0.175	0.380	0.175	0.380
HLTHFAIR	Self-evaluation of the individual's health : if fair, HLTHFAIR=1 ; otherwise=0.	0.368	0.482	0.401	0.490

EDU	The average proportion of high school graduates who went to either college or university in a prefecture.	0.296	0.061	0.439	0.078
LIFEINSU	The average amount of life insurance's contract (in 10,000 Yen) in a prefecture.	781.57	64.93	779.91	65.03
POP1M	If a resident of a city with a population of 1 million or more, POP1M=1 ; otherwise=0.	0.139	0.346	0.138	0.345
POP150	If a resident in a city with a population of more than 150,000 & less than 1 million, POP150=1 ; otherwise=0.	0.266	0.442	0.269	0.444
POP50	If a resident in a city with a population of more than 50,000 but less than 150,000, POP50=1 ; otherwise=0.	0.094	0.291	0.095	0.293
POPCUNTY	If a resident in a city or town with a population less than 50,000, POPCUNTY=1 ; otherwise=0.	0.290	0.454	0.287	0.452
REGIOND1	Regional Dummy : Hokkaido=1 ; otherwise=0.	0.020	0.141	0.022	0.148
REGIOND2	Regional Dummy : Tohoku=1 ; otherwise=0.	0.139	0.346	0.138	0.345
REGIOND4	Regional Dummy : Kanto II=1 ; otherwise=0.	0.115	0.318	0.108	0.310
REGIOND5	Regional Dummy : Hokuriku=1 ; otherwise=0.	0.087	0.282	0.087	0.282
REGIOND6	Regional Dummy : Toukai=1 ; otherwise=0.	0.073	0.261	0.071	0.256
REGIOND7	Regional Dummy : Kinki I=1 ; otherwise=0.	0.046	0.209	0.046	0.210
REGIOND8	Regional Dummy : Kinki II=1 ; otherwise=0.	0.061	0.240	0.061	0.240
REGIOND9	Regional Dummy : Cyugoku=1 ; otherwise=0.	0.103	0.304	0.104	0.305
REGIOND10	Regional Dummy : Shikoku=1 ; otherwise=0.	0.075	0.263	0.078	0.268
REGIOND11	Regional Dummy : Kita Kyushu = 1 ; otherwise =0.	0.087	0.282	0.092	0.290
REGIOND12	Regional Dummy : Minami Kyusyu=1 ; otherwise=0.	0.073	0.260	0.077	0.267

tions grouped according to type of health insurance. In Table 5 we report results for male and female insurants of the National Health Insurance. Table 6 shows the results for the NHI male sample for different age groups, while Table 7 shows their female counterparts'. About our empirical results in the Tables, we will mainly discuss those factors of interest that contribute to the differentials in the demand for health check-up.

1 Health Check-up Results of Males and Females of the 20-64 Age Group

First, we consider the respective results of the males (N=214,948) and the females (N=223,958) in Table 3. The age variable (AGE) is highly significant in both males (0.046) and females (0.032). The positive estimated coefficients on AGE and the negative estimated coefficients on AGESQ for both males and females indicate that the profile of their health check-up rate is concave as age increases.[26] The marginal effects of AGE on the demand for health check-up are 0.015 for males and 0.011 for females.[27] The age elasticity of health check-up without the AGESQ term is about 1.67 for males and about 1.20 for females at the sample means. After

Table 3 Health Check-up Rate : Gender-Specific PROBIT Results (Age Group 20-64)

Variable	Males			Females		
	Estimate	t-statistic*	Marginal	Estimate	t-statistic*	Marginal
C	−1.398	−16.684	—	−1.159	−14.764	—
AGE	0.046	13.506	0.015	0.032	14.800	0.011
AGESQ	0.000	−11.068	0.000	0.000	−5.319	0.000
MATERNITY	—	—	—	−0.142	−17.633	−0.030
MARRIED	0.146	17.156	0.048	−0.086	−9.281	−0.049
WAGE	−0.099	−5.600	−0.032	−0.042	−1.964	−0.015
BREADWIN	0.105	12.273	0.034	−0.028	−2.767	−0.010
MONTHEXP	0.000	2.871	0.000	0.000	4.257	0.000
MOEXPDUM	−0.105	−8.528	−0.034	−0.065	−5.323	−0.022
NHI	−0.130	−5.096	−0.043	0.053	1.970	0.018
GOVTHI	0.201	7.930	0.064	0.229	8.527	0.079
SOCIHI	0.309	11.962	0.099	0.328	12.070	0.112
MUTUHI	0.335	11.799	0.105	0.326	11.558	0.112
PROPRIET	−0.330	−19.768	−0.110	−0.199	−7.036	−0.069
FAMILYWK	−0.383	−15.634	−0.127	−0.262	−9.816	−0.090
SIZE1	−0.363	−15.929	−0.120	−0.246	−8.176	−0.085
SIZE5	−0.063	−3.970	−0.020	0.061	2.425	0.021
SIZE30	0.256	15.816	0.080	0.347	13.487	0.119
SIZE100	0.447	27.316	0.138	0.558	21.258	0.188
SIZE500	0.498	24.046	0.149	0.636	19.735	0.210
SIZE1000	0.622	36.284	0.188	0.824	28.881	0.266
PUBEMPLY	0.481	21.464	0.147	0.673	22.675	0.223
PARTTIME	−0.085	−3.135	−0.027	0.060	2.193	0.021
HUSWRKR	−0.189	−5.593	−0.062	−0.174	−5.917	−0.060
NOJOB	−0.175	−8.275	−0.058	−0.317	−11.119	−0.116
PROFES	0.016	1.036	0.005	0.110	5.762	0.038
ADMINI	0.111	6.363	0.035	−0.075	−2.587	−0.026
CLERIC	0.071	4.462	0.023	0.077	4.261	0.027
SALES	−0.080	−4.905	−0.026	−0.098	−5.124	−0.034
SERVIC	−0.098	−5.667	−0.032	−0.125	−6.638	−0.043
AGRICU	0.230	11.040	0.072	0.235	9.474	0.081
FOREST	0.068	1.157	0.022	−0.078	−0.809	−0.027
FISHER	−0.030	−0.834	−0.010	0.025	0.430	0.009
TRANSP	−0.024	−1.246	−0.008	−0.054	−0.992	−0.019
CRAFTM	−0.009	−0.641	−0.003	−0.044	−2.407	−0.015
DOCTOR	0.000	2.233	0.000	0.000	0.764	0.000
SICKNUMB	0.145	32.685	0.047	0.133	35.677	0.046
STRESS	0.060	27.306	0.019	0.043	23.929	0.017
NOTVISIT	−0.142	−13.060	−0.046	−0.178	−18.155	−0.062
HLTHPRAC	0.078	47.390	0.026	0.086	54.173	0.030

HLTHEXCE	0.503	46.462	0.155	0.353	33.779	0.120
HLTHGOOD	0.571	49.484	0.172	0.409	37.558	0.139
HLTHFAIR	0.542	53.502	0.169	0.392	41.632	0.134
EDU	−0.616	−7.637	−0.198	−0.810	−10.592	−0.280
LIFEINSU	0.000	−6.473	0.000	0.000	−5.979	0.000
POP1M	−0.033	−2.827	−0.011	−0.052	−4.580	−0.018
POP150	−0.035	−4.080	−0.012	−0.081	−9.816	−0.028
POP50	0.052	4.444	0.017	0.132	11.905	0.045
POPCUNTY	0.160	18.502	0.051	0.264	32.301	0.092
REGIOND1	−0.176	−7.198	—	−0.307	−11.707	—
REGIOND2	0.056	3.512	—	0.062	3.197	—
REGIOND4	−0.008	−0.581	—	0.009	0.681	—
REGIOND5	0.079	4.325	—	0.058	3.926	—
REGIOND6	0.022	1.270	—	0.015	1.021	—
REGIOND7	−0.149	−8.402	—	−0.083	−4.695	—
REGIOND8	−0.196	−11.721	—	−0.142	−8.644	—
REGIOND9	−0.054	−3.121	—	−0.038	−2.254	—
REGIOND10	−0.267	−14.004	—	−0.154	−8.497	—
REGIOND11	−0.143	−7.943	—	−0.125	−6.913	—
REGIOND12	−0.125	−6.741	—	−0.080	−3.967	—
R-squared	0.19463			0.16283		
Log Likelihood	−121879			−135856		
N	214,948			223,958		

Notes : * Asymptotic t-statistics : the critival value at 1% significance level=2.576 ; the critical value at 5% significance level=1.960 ; and the critical value at 10% significance level=1.645.

controlling for other socio-economic and demographic variables, we find that both males and females become more concerned with their health as age increases ; this may be due to the individual's loss of health stock.

Earlier we hypothesized that individuals tend not to have the health check-up as pecuniary and non-pecuniary costs rise, especially with women aged 30-39 (MATERNITY) who get married, expect a child, and raise their children at this stage in life. The costs of health check-up are not only the price of health check-up in clinics and hospitals, but also the opportunity costs. The women of this age group then are less likely to have the health check-up when the costs are not negligible. The sign of the MATERNITY variable is negative (−0.142) and highly significant. The marginal effect is −0.030, which indicates that the married women of this 30-39 age group will have a substantially lower probability of taking the health check-up by about 8 percentage points than single females of other age groups, since the sum of the marginal effects of MATERNITY and MARRIED is −0.079.[28)]

The health check-up is a time-consuming health input. An individual has to give up working hours or days for the sake of the health check-up, thus the wages (WAGE) can be considered a proxy for the opportunity costs to some extent. The sign of WAGE is negative for males (−0.099) and females (−0.042) ; both are significant. The marginal effects are −0.032 and −0.015 for males and females, respectively ; the respective wage elasticities of the health check-up are −0.10 and −0.04. High opportunity costs, or higher wages, are a major deterrent in the demand for

Table 4 Health Check-up Rate : Insurance Type-Specific PROBIT Results

Variable	NHI		GOVTHI		SOCIHI		MUTUHI	
	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*
C	−0.746	−8.648	−1.106	−12.982	−1.491	−13.821	−1.199	−7.467
AGE	0.015	5.118	0.042	15.218	0.051	14.232	0.066	11.689
AGESQ	0.000	0.169	0.000	−8.989	0.000	−9.620	−0.001	−8.330
FEMALE	0.042	4.793	−0.024	−2.999	−0.029	−2.664	−0.066	−4.302
MARRIED	0.087	9.304	−0.045	−4.630	−0.050	−3.915	−0.085	−4.049
WAGE	−0.142	−7.916	−0.104	−5.867	−0.062	−2.963	−0.189	−5.675
BREADWIN	0.087	8.090	0.062	6.005	0.127	9.673	0.106	5.426
MONTHEXP	0.000	2.696	0.000	2.824	0.000	4.038	0.000	2.520
MOEXPDUM	−0.037	−2.583	−0.128	−8.253	−0.100	−5.420	−0.036	−1.190
PROPRIET	−0.197	−6.760	−0.298	−11.046	−0.495	−11.204	−0.556	−6.346
FAMILYWK	−0.205	−6.654	−0.286	−9.206	−0.526	−8.752	−0.238	−1.927
SIZE1	−0.188	−5.628	−0.319	−11.465	−0.533	−10.863	−0.708	−6.941
SIZE5	−0.020	−0.627	0.050	2.658	−0.197	−6.555	−0.236	−3.718
SIZE30	0.216	6.170	0.358	18.895	0.083	2.892	0.017	0.269
SIZE100	0.529	13.020	0.549	28.089	0.299	10.814	0.116	1.946
SIZE500	0.676	10.106	0.625	22.572	0.373	12.453	−0.051	−0.668
SIZE1000	0.998	19.345	0.710	24.974	0.503	18.921	0.293	4.954
PUBEMPLY	0.380	3.840	0.528	9.372	0.373	5.637	0.251	4.868
PARTTIME	−0.029	−0.825	0.043	1.569	−0.151	−4.263	−0.304	−4.758
HUSWRKR	−0.186	−5.064	−0.176	−5.057	−0.356	−8.385	−0.390	−5.452
NOJOB	−0.204	−5.964	−0.310	−11.622	−0.532	−15.767	−0.734	−12.623
PROFES	0.061	2.726	0.110	4.988	0.043	1.739	−0.018	−0.620
ADMINI	0.044	1.396	0.094	3.612	0.131	4.304	0.030	0.878
CLERIC	0.001	0.050	0.131	6.146	0.085	3.598	0.041	1.428
SALES	−0.104	−4.788	−0.068	−3.090	0.008	0.320	−0.179	−3.346
SERVIC	−0.107	−4.857	−0.085	−3.741	−0.063	−2.317	−0.079	−1.875
AGRICU	0.181	8.005	0.202	4.336	0.182	2.570	0.014	0.180
FOREST	−0.003	−0.039	0.008	0.094	−0.253	−1.456	0.082	0.356
FISHER	−0.103	−2.661	−0.099	−1.006	−0.126	−0.846	−0.518	−2.490
TRANSP	−0.061	−1.632	−0.036	−1.287	−0.051	−1.450	0.061	1.302
CRAFTM	−0.018	−0.883	0.012	0.583	−0.034	−1.450	−0.126	−2.755
DOCTOR	0.000	2.628	0.000	−0.308	0.000	−0.273	0.000	0.067
SICKNUMB	0.157	35.798	0.128	24.592	0.130	19.168	0.121	11.715
STRESS	0.042	17.430	0.044	18.210	0.059	20.357	0.049	11.623
NOTVISIT	−0.182	−14.466	−0.136	−10.890	−0.177	−11.381	−0.159	−6.636
HLTHPRAC	0.089	46.169	0.078	39.018	0.080	32.434	0.070	19.270
HLTHEXCE	0.347	27.346	0.417	31.306	0.531	33.007	0.440	18.311
HLTHGOOD	0.408	30.292	0.464	32.972	0.584	34.681	0.549	21.973
HLTHFAIR	0.379	33.356	0.456	36.966	0.566	37.627	0.528	23.546
EDU	−0.643	−7.950	−0.805	−10.406	−0.490	−4.610	−0.482	−3.394
LIFEINSU	−0.001	−9.375	0.000	−3.663	0.000	0.775	0.000	0.228
POP1M	0.011	0.773	−0.081	−5.501	−0.048	−3.218	−0.063	−2.430
POP150	−0.067	−6.171	−0.063	−6.065	−0.050	−4.214	−0.057	−3.027
POP50	0.102	7.411	0.105	7.827	0.077	3.991	0.045	1.810
POPCUNTY	0.274	26.559	0.206	20.443	0.137	10.395	0.142	7.601
R-squared	0.12064		0.14146		0.18251		0.19170	
Log Likelihood	−85409.0		−86020.5		−57768.9		−25520.1	
N	138,308		142,069		104,113		48,873	

Notes : All equations include the 11 regional dummy variables.

* Asymptotic t-statistics : the critival value at 1% significance level=2.576 ; the critical value at 5% significance level=1.960 ; and the critical value at 10% significance level=1.645.

Table 5 Health Check-up Rate : PROBIT Results for Male and Female NHI Insurants

Variable	NHI Males			NHI Females		
	Estimate	t-statistic*	Marginal	Estimate	t-statistic*	Marginal
C	−0.510	−3.565	—	−0.940	−6.982	—
AGE	0.007	1.106	0.002	0.009	2.521	0.003
AGESQ	0.000	0.339	0.000	0.000	2.467	0.000
MATERNITY	—	—	—	−0.168	−10.195	−0.058
MARRIED	0.146	9.916	0.051	0.044	2.948	0.015
WAGE	−0.070	−2.316	−0.025	0.012	0.315	0.004
BREADWIN	0.167	10.832	0.059	−0.004	−0.249	−0.002
MONTHEXP	0.000	1.783	0.000	0.000	1.992	0.000
MOEXPDUM	−0.052	−2.560	−0.018	−0.030	−1.496	−0.010
PROPRIET	−0.232	−6.846	−0.081	−0.016	−0.284	−0.006
FAMILYWK	−0.299	−7.410	−0.102	−0.110	−1.952	−0.038
SIZE1	−0.240	−5.961	−0.082	−0.049	−0.791	−0.017
SIZE5	−0.046	−1.222	−0.016	0.085	1.443	0.030
SIZE30	0.216	5.076	0.078	0.278	4.375	0.098
SIZE100	0.509	10.102	0.184	0.602	8.446	0.210
SIZE500	0.757	9.005	0.268	0.523	4.571	0.183
SIZE1000	1.051	16.660	0.360	0.862	9.287	0.292
PUBEMPLY	0.298	2.046	0.107	0.568	4.102	0.198
PARTTIME	−0.082	−1.829	−0.029	0.132	2.181	0.046
HUSWRKR	−0.184	−3.583	−0.063	−0.082	−1.326	−0.028
NOJOB	−0.113	−2.640	−0.040	−0.153	−2.507	−0.053
PROFES	0.059	2.041	0.021	0.052	1.422	0.018
ADMINI	0.069	1.802	0.024	−0.061	−1.021	−0.021
CLERIC	0.031	0.732	0.011	−0.001	−0.035	0.000
SALES	−0.090	−3.089	−0.032	−0.125	−3.782	−0.043
SERVIC	−0.101	−3.240	−0.035	−0.131	−4.030	−0.045
AGRICU	0.204	6.863	0.073	0.198	5.606	0.070
FOREST	0.110	1.372	0.039	−0.139	−0.960	−0.048
FISHER	−0.106	−2.274	−0.037	0.033	0.462	0.012
TRANSP	−0.069	−1.649	−0.024	−0.041	−0.381	−0.014
CRAFTM	0.000	0.002	0.000	−0.042	−1.265	−0.015
DOCTOR	0.000	2.147	0.000	0.000	0.440	0.000
SICKNUMB	0.173	25.455	0.061	0.146	25.208	0.051
STRESS	0.047	12.768	0.017	0.042	13.110	0.014
NOTVISIT	−0.177	−9.549	−0.061	−0.182	−10.636	0.063
HLTHPRAC	0.079	28.487	0.027	0.099	36.853	0.033
HLTHEXCE	0.398	21.596	0.140	0.307	17.410	0.106
HLTHGOOD	0.465	23.519	0.166	0.364	19.666	0.127
HLTHFAIR	0.412	24.379	0.145	0.354	22.908	0.123
EDU	−0.750	−5.365	−0.265	−0.496	−3.645	−0.017
LIFEINSU	−0.001	−8.092	0.000	−0.001	−5.826	0.000
POP1M	0.021	0.992	0.007	−0.024	−1.168	−0.008
POP150	−0.034	−2.166	−0.012	−0.101	−6.809	−0.035
POP50	0.081	4.025	0.029	0.127	6.657	0.045
POPCUNTY	0.245	16.290	0.088	0.308	21.547	0.109
R-squared	0.11028			0.13884		
Log Likelihood	−40781.2			−44235.1		
N	65,856			72,452		

Notes : All equations include the 11 regional dummy variables.

* Asymptotic t-statistics : the critival value at 1% significance level=2.576 ; the critical value at 5% significance level=1.960 ; and the critical value at 10% significance level=1.645.

Table 6 Health Check-up Rate : PROBIT Results for NHI Male Insurants by Age Group

Variable	20～29		30～39		40～49		50～60		61～64	
	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*
C	−0.279	−0.244	3.593	1.620	0.190	0.063	0.090	0.025	28.350	0.579
AGE	0.014	0.159	−0.194	−1.513	−0.016	−0.119	−0.033	−0.250	−0.918	−0.586
AGESQ	0.000	0.100	0.003	1.644	0.000	0.111	0.000	0.336	0.007	0.591
MARRIED	−0.023	−0.601	0.154	4.781	0.187	6.629	0.209	6.383	0.156	3.370
WAGE	−0.306	−1.687	−0.285	−1.984	0.040	0.408	−0.055	−0.894	−0.028	−0.196
BREADWIN	0.341	10.441	0.127	3.519	0.047	1.333	0.081	1.890	0.082	2.200
MONTHEXP	0.000	0.190	0.000	−0.397	0.000	0.730	0.000	1.923	0.000	1.303
MOEXPDUM	−0.138	−2.845	−0.054	−0.973	−0.003	−0.065	−0.033	−0.864	−0.073	−1.312
PROPRIET	−0.218	−1.958	−0.352	−4.393	−0.218	−3.572	−0.220	−3.473	−0.213	−2.104
FAMILYWK	−0.274	−2.471	−0.272	−3.064	−0.285	−3.671	−0.276	−2.872	−0.445	−3.222
SIZE1	−0.234	−2.067	−0.276	−2.986	−0.184	−2.492	−0.276	−3.487	−0.204	−1.553
SIZE5	−0.091	−0.840	−0.024	−0.274	0.008	0.120	−0.035	−0.484	−0.128	−1.104
SIZE30	0.223	1.920	0.257	2.622	0.197	2.466	0.253	3.016	0.063	0.480
SIZE100	0.487	3.877	0.581	5.364	0.568	5.763	0.473	4.234	0.061	0.357
SIZE500	0.540	3.174	1.035	5.213	0.748	4.822	0.753	3.700	1.367	2.338
SIZE1000	0.928	6.778	1.205	8.385	1.031	8.533	1.082	7.162	0.565	1.772
PUBEMPLY	0.246	0.737	0.307	0.957	0.255	0.546	0.837	2.231	−0.032	−0.119
PARTTIME	−0.048	−0.398	−0.130	−1.107	−0.131	−1.389	−0.114	−1.309	−0.042	−0.362
HUSWRKR	−0.202	−1.475	−0.159	−1.200	−0.169	−1.586	−0.230	−2.308	−0.168	−1.308
NOJOB	0.007	0.060	−0.196	−1.831	−0.295	−3.418	−0.082	−0.974	−0.261	−2.210
PROFES	0.153	1.955	−0.008	−0.113	0.055	0.997	0.115	2.127	−0.087	−1.058
ADMINI	−0.109	−0.747	−0.176	−1.766	0.137	1.921	0.144	2.142	0.065	0.636
CLERIC	0.060	0.649	−0.160	−1.663	−0.010	−0.115	0.129	1.393	0.186	1.361
SALES	−0.110	−1.374	−0.251	−3.386	−0.078	−1.383	0.002	0.043	−0.144	−1.796
SERVIC	−0.187	−2.370	−0.306	−3.901	−0.088	−1.451	0.054	0.942	−0.087	−0.943
AGRICU	0.066	0.629	−0.036	−0.447	0.153	2.591	0.338	6.269	0.139	1.897
FOREST	−0.532	−1.097	−0.438	−1.259	0.016	0.093	0.266	2.107	0.142	0.585
FISHER	0.012	0.076	−0.433	−3.271	−0.090	−0.974	0.031	0.375	−0.217	−1.947
TRANSP	−0.118	−1.105	−0.254	−2.472	−0.059	−0.731	0.114	1.457	−0.167	−1.215
CRAFTM	0.095	1.358	−0.069	−1.039	−0.019	−0.358	0.059	1.193	−0.084	−1.191
DOCTOR	0.001	0.975	0.000	0.156	0.002	3.399	0.000	−1.123	0.000	0.558
SICKNUMB	0.141	4.356	0.003	2.013	0.190	11.942	0.166	15.015	0.181	14.550
STRESS	0.035	3.373	0.043	4.897	0.037	5.559	0.053	7.436	0.083	7.595
NOTVISIT	−0.003	−0.065	−0.105	−2.046	−0.205	−5.966	−0.245	−7.137	−0.211	−4.357
HLTHPRAC	0.066	8.704	0.065	8.650	0.056	9.957	0.095	18.173	0.108	16.983
HLTHEXCE	0.323	5.873	0.316	6.196	0.379	9.995	0.403	12.101	0.405	9.478
HLTHGOOD	0.408	6.937	0.348	6.352	0.407	10.026	0.482	13.434	0.523	11.613
HLTHFAIR	0.360	6.620	0.284	5.749	0.364	10.426	0.437	14.779	0.454	12.514
EDU	−0.772	−1.952	−0.834	−2.175	−1.232	−4.324	−0.453	−1.723	−0.609	−1.827
LIFEINSU	−0.001	−4.078	−0.001	−2.751	−0.001	−4.423	0.000	−2.293	−0.001	−2.914
POP1M	0.039	0.789	0.053	0.938	−0.084	−1.883	0.078	1.870	−0.035	−0.625
POP150	0.001	0.016	0.019	0.457	−0.079	−2.473	−0.024	−0.786	−0.095	−2.442
POP50	0.001	0.012	0.043	0.779	0.132	3.379	0.096	2.556	0.076	1.623
POPCUNTY	0.134	3.224	0.251	6.217	0.242	8.123	0.261	9.278	0.309	8.647
R-squared	0.08392		0.09370		0.08229		0.10132		0.11750	
Log Likelihood	−5927.91		−5748.80		−10333.0		−11556.5		−6933.40	
N	10,629		9,631		16,420		18,166		11,010	

Notes : All equations include the 11 regional dummy variables.

* Asymptotic t-statistics : the critical value at 1% significance level=2.576 ; the critical value at 5% significance level=1.960 ; and the critical value at 10% significance level=1.645.

Table 7 Health Check-up Rate : PROBIT Results for NHI Female Insurants by Age Group

Variable	20～29		30～39		40～49		50～60		61～64	
	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*	Estimate	t-statistic*
C	−2.254	−1.893	−1.631	−0.735	−0.783	−0.258	−2.553	−0.846	40.711	0.904
AGE	0.168	1.782	0.063	0.491	−0.036	−0.266	0.059	0.542	−1.292	−0.897
AGESQ	−0.003	−1.721	−0.001	−0.279	0.001	0.459	0.000	−0.363	0.010	0.887
MARRIED	−0.300	−8.454	−0.013	−0.341	0.154	4.139	0.152	5.202	0.101	2.803
WAGE	−0.054	−0.253	−0.105	−0.775	0.210	2.601	−0.014	−0.241	0.100	1.055
BREADWIN	0.258	6.382	−0.042	−0.786	−0.046	−1.081	−0.003	−0.085	−0.011	−0.262
MONTHEXP	0.000	0.330	0.000	0.514	0.000	−0.317	0.001	2.364	0.000	0.688
MOEXPDUM	−0.039	−0.769	0.065	1.198	−0.027	−0.661	−0.074	−2.082	−0.067	−1.246
PROPRIET	−0.065	−0.427	0.011	0.074	0.001	0.007	0.133	1.271	−0.173	−0.902
FAMILYWK	−0.198	−1.352	−0.183	−1.304	−0.175	−1.687	0.065	0.622	−0.194	−1.016
SIZE1	−0.116	−0.794	−0.085	−0.559	−0.022	−0.191	0.117	0.997	−0.281	−1.258
SIZE5	−0.022	−0.152	0.094	0.648	0.083	0.754	0.244	2.206	−0.130	−0.632
SIZE30	0.248	1.676	0.310	1.965	0.158	1.305	0.409	3.412	0.148	0.662
SIZE100	0.621	3.925	0.538	3.077	0.696	5.030	0.556	4.001	0.120	0.460
SIZE500	0.359	1.700	0.578	2.069	0.706	2.825	0.409	1.708	0.358	0.603
SIZE1000	0.957	5.298	0.819	3.825	0.775	3.834	0.600	3.015	0.286	0.666
PUBEMPLY	0.724	2.591	0.392	1.343	0.547	1.768	0.594	1.932	0.131	0.302
PARTTIME	−0.015	−0.102	0.043	0.289	0.141	1.225	0.368	3.247	−0.032	−0.157
HUSWRKR	−0.237	−1.495	−0.092	−0.594	−0.133	−1.147	0.170	1.487	−0.203	−1.003
NOJOB	−0.182	−1.220	−0.258	−1.670	−0.252	−2.195	0.135	1.207	−0.308	−1.520
PROFES	0.081	0.932	0.104	1.151	0.008	0.115	0.116	1.656	−0.293	−2.411
ADMINI	−0.206	−1.078	0.164	1.037	−0.199	−1.750	0.060	0.587	−0.109	−0.631
CLERIC	0.019	0.231	0.010	0.110	−0.019	−0.278	0.013	0.184	−0.333	−2.533
SALES	−0.281	−3.201	−0.136	−1.578	−0.147	−2.380	−0.010	−0.170	−0.082	−0.807
SERVIC	−0.298	−3.525	−0.163	−1.909	−0.169	−2.774	0.035	0.607	−0.145	−1.417
AGRICU	0.256	1.621	0.017	0.173	0.235	3.401	0.326	5.330	0.089	0.913
FOREST	−0.227	−0.351	−0.412	−0.935	−0.510	−1.769	−0.079	−0.334	0.725	1.712
FISHER	−0.622	−1.576	−0.296	−1.461	0.005	0.038	0.232	1.994	0.041	0.207
TRANSP	0.054	0.233	−0.325	−1.233	0.097	0.473	0.089	0.428	−1.166	−2.122
CRAFTM	−0.069	−0.717	−0.050	−0.565	−0.072	−1.156	0.076	1.293	−0.148	−1.466
DOCTOR	0.001	0.943	0.001	1.412	−0.001	−1.434	0.000	−1.174	0.001	1.238
SICKNUMB	0.110	4.437	0.106	4.598	0.136	9.605	0.141	15.761	0.172	15.287
STRESS	0.037	3.998	0.022	3.119	0.040	6.325	0.049	8.329	0.073	7.647
NOTVISIT	−0.105	−2.006	−0.070	−1.562	−0.175	−5.367	−0.252	−8.180	−0.227	−5.116
HLTHPRAC	0.063	7.875	0.057	7.214	0.086	14.625	0.105	22.833	0.144	24.257
HLTHEXCE	0.324	5.873	0.176	3.414	0.253	6.595	0.331	11.041	0.334	8.310
HLTHGOOD	0.329	5.640	0.221	4.094	0.357	8.742	0.394	12.488	0.375	9.129
HLTHFAIR	0.311	5.860	0.178	3.692	0.298	8.615	0.404	15.940	0.395	12.120
EDU	−0.530	−1.378	−1.221	−3.294	0.166	0.545	−0.445	−1.829	−0.683	−2.230
LIFEINSU	−0.001	−3.007	0.000	−1.562	0.000	−1.329	−0.001	−3.180	−0.001	−3.207
POP1M	0.011	0.217	−0.007	−0.114	−0.021	−0.485	−0.079	−2.170	−0.019	−0.377
POP150	−0.049	−1.194	−0.160	−3.832	−0.104	−3.293	−0.111	−4.263	−0.100	−2.853
POP50	0.060	1.007	0.071	1.341	0.167	4.119	0.133	4.046	0.152	3.500
POPCUNTY	0.239	5.680	0.284	7.239	0.314	10.396	0.300	12.019	0.375	11.312
R-squared	0.07749		0.06600		0.08276		0.10206		0.13514	
Log Likelihood	−5471.05		−5724.49		−9900.48		−14628.1		−8056.22	
N	10,383		10,252		15,737		22,900		13,180	

Notes : All equations include the 11 regional dummy variables.

* Asymptotic t-statistics : the critical value at 1% significance level=2.576 ; the critical value at 5% significance level=1.960 ; and the critical value at 10% significance level=1.645.

health check-up and the effect works much stronger against males than females. On the other hand, the estimated coefficient on the variable BREADWIN is significantly positive for males (0.105) and the robust effect shows, as previously hypothesized, that the highest earner of a household is more willing to have the health check-up to secure loss of earnings that would arise from becoming ill. The negative and significant coefficient is a little puzzling in the case of females (−0.028) ; since the marginal effect for males is about 0.034 while that for females is −0.010, this difference becomes another factor resulting in the male-female differentials with respect to the health check-up. From the estimated coefficient on monthly household expenditures (i.e., MONTHEXP), we see that the income elasticity of the demand for health check-up is positive. Although the estimated coefficients for both males and females are reported to be substantially small (0.000) and both marginal effects are about 0.0001, the income (or expenditure) elasticity of demand for health check-up is inelastic—about 0.01 for both males and females.

As a policy variable, we include the types of individual's health insurance coverage in the model : NHI, GOVTHI, SOCIHI, and MUTUHI. As expected, the estimated coefficient of the NHI (National Health Insurance) for males is negative (−0.130) while positive for the rest : 0.201 for GOVTHI, 0.309 for SOCIHI, and 0.335 for MUTUHI. Their respective marginal effects are −0.043, 0.064, 0.099, and 0.105. The marginal effects for females are 0.018 (NHI), 0.079 (GOVTHI), 0.112 (SOCIHI), and 0.112 (MUTUHI). All estimates are statistically highly significant. These large differences in the marginal effect between males (or females) with NHI and those with the other types of health insurance indicate that people with either SOCIHI or MUTUHI have advantages in accessing the health check-up by about 10 percentage points or more. Hence, the higher the coverage of the health check-up costs is, the more the individual is likely to have the health check-up. We consider that the difference in the coverage is one of the major causes that differentiates the health check-up of people with NHI from those with other types of health insurance.

Next, we evaluate the effects of firm size on the demand for health check-up. Firms are legally bound to provide the health check-up to their employees. Firms with a larger number of employees are subject to more legal bindings or rules regarding employees' working conditions. In addition, the firms face their well-organized and stronger labor unions. Therefore, large firms usually provide more and better fringe benefits as compared to small firms. In our study, we use various sizes of firms, such as SIZE1 for those with 1-4 employees, SIZE1000 for institutions with 1,000 employees or more, and PUBEMPLY for public employees.[29] In addition, we also include other employment-status variables : PROPRIET, FAMILYWK, PARTTIME, HUSWRKR and NOJOB. Among all these variables, the estimated coefficients on the variables SIZE30 to SIZE1000 and PUBEMPLY are positive and statistically highly significant for both males and females. For example, the marginal effects for males are 0.080 (SIZE30), 0.138 (SIZE100), 0.149 (SIZE500), 0.188 (SIZE1000) and 0.147 (PUBEMPLY) ; those for females are 0.119 (SIZE30), 0.188 (SIZE100), 0.210 (SIZE500), 0.266 (SIZE1000) and 0.223 (PUBEMPLY). In comparison to these large effects, one of the negative marginal effects of employment status, say HUSWRKR, is −0.062 for males and −0.060 for females. Furthermore, if an individual does not have a job (NOJOB) , the marginal effects are −0.058 for males and −0.116 for females. We say that the difference in the demand for health check-up will be about 0.33 between females with SIZE1000 and female of a home-based employee (HUSWRKR). Instead of HUSWRKR, if NOJOB is used, then the difference is about 0.38 for females.[30] These results are

indicative of the provision of better working environments for employees in larger-sized firms and the firms' high degree of compliance with the law. These provisions create the major differences in the health check-up rates among females with different employment environments, and between females and males.

Regarding the effects of an individual's health conditions on the demand for health check-up, holding constant the subjective evaluation of an individual's health condition (HLTHEXCE, HLTHGOOD, and HLTHFAIR) ; these variables are highly significant for both males and females. The sign of the estimated coefficient on NOTVISIT (did not visit medical institutions for the past year) is negative, while the one on HLTHPRAC is positive : −0.142 and 0.078 for males and −0.178 and 0.086 for females, respectively.[31] The marginal values of NOTVISIT and HLTHPRAC are −0.046 and 0.026 for males, and −0.062 and 0.030 for females, respectively. That is, individuals with better health or more health stock (NOTVISIT), are less likely to have the health check-up. On the other hand, health conscious people, individuals who practice health stock augmenting activities (HLTHPRAC), are likely to have the health check-up more than otherwise. For health conscious people, the health check-up is another means of preventing health deterioration.

We hypothesized in the previous discussion that the psychological burdens of being in queue in hospitals and of being ill will pressure the individual not to become ill. It is thus possible that the individual will tend toward having the health check-up so as to avoid becoming a patient. The variables of SICKNUMB (the number of injuries and illnesses) and STRESS (the number of stressful events encountered) are included as proxy for psychological burden. The estimated coefficients of SICKNUMB and STRESS are significantly robust and those are 0.145 and 0.060 for males, respectively ; the respective values for females are 0.133 and 0.043. The marginal effects of SICKNUMB are about 0.047 for males and 0.046 for females ; those of STRESS are about 0.019 for males and 0.017 for females. These marginal effects are very similar between males and females.

Finally in Table 3, we discuss the estimated coefficients on education (EDU) and life insurance (LIFEINSU).[32] Both variables have negative signs on their estimated coefficients. The level of an individual's education is considered a factor in the increased efficiency of health production. Normally, the variable has a positive effect on the demand for preventive medical care (Coffey 1983, Kenkel 1994, and Hsieh and Lin 1997). However, the coefficient of education depends on the elasticity of the MEC schedule, or the demand for health stock. The sign of an individual's education level is negative if the elasticity is less than one in absolute values (Grossman 1972). In this respect, our estimated negative coefficient is not necessarily wrong.[33] The estimated effect of LIFEINSU on the demand for health check-up is negative, as theoretically predicted. That is, an individual with life insurance is less likely to have the health check-up. This result is like an old story about an individual who buys insurance but who gambles at the same time, as often discussed within the pages of a regular textbook regarding behavior under uncertainty (see Silberberg 1990, p. 453). From another perspective, it also may be viewed that the significantly negative coefficient reflects the moral hazard of an individual's behavior.

2 Health Check-up Results by Health Insurance Type

Now, we highlight the results of NHI in comparison with those of the GOVTHI, the SOCIHI, and the MUTUHI in Table 4. The effect of AGE is significantly positive across the different types of health insurance ; the respective marginal effects (not shown in Table 4) are 0.005 (NHI), 0.015 (GOVTHI), 0.016 (SOCIHI), and 0.020 (MUTUHI). Thus, the increments of NHI as age

increases are one third or less that of the other types of health insurance. Again, the type of insurance, representing the coverage of medical costs, is really an important factor in determining for an individual whether to have health check-up or not. Consequently, NHI insurants have lower health check-up rates as compared to those covered by other health insurance schemes.

FEMALE and MARRIED variables under the NHI are some of the few variables that have different signs on the estimated coefficients from those of other types of health insurance. The effects of FEMALES (0.042) and MARRIED (0.087) are both significant and positive, while negative in the other health insurances ; the corresponding marginal effects are 0.015 and 0.031. Under the NHI, married females are more likely to have the health check-up more than single females, married males, and single males. This last group, the single males, has the least demand for health check-up under the NHI scheme. On the other hand, the results are opposite for GOVTHI, SOCIHI and MUTUHI : married females have the least demand for the health check-up. Since firms are very unlikely to discriminate only against married women, the low rate of health check-up among married women covered by those health insurances are probably due to individual-decision making. Therefore, as long as these demographic factors are concerned, policy makers need to understand the basic needs that motivate married women to take the health check-up.

The employment status variables, PROPRIET, FAMILYWK, SIZE1, HUSWRKR and NOJOB are negative regardless of the type of health insurance. These workers are highly disadvantaged in terms of health check-up opportunities relative to those employed in large-sized firms or by public institutions. For example, in the NHI model, the marginal effects (not shown in Table 4) are −0.068 (PROPRIET), −0.071 (FAMILYWK), −0.065 (SIZE1), −0.064 (HUSWRKR) and −0.071 (NOJOB), in comparison with the 0.339 of SIZE1000. Naturally, people who have the NHI but are employed in large-sized firms must be quite small in their number, while the majority of people with the NHI are likely in either one of the other above-mentioned employment-status categories. Hence, the average health check-up rate must be low relative to those with GOVTHI, SOCIHI and MUTUHI. We also note among various occupations that those of SALES and SERVIC are faced with similar disadvantages in the health check-up. The estimated coefficients of SALES and SERVIC under NHI are −0.104 and −0.107 and the respective marginal effects are −0.036 and −0.037. In comparison, their respective marginal effects are −0.024 and −0.029 for GOVTHI, 0.003 and −0.020 for SOCIHI and −0.055 and −0.024 for MUTUHI. Hence, regardless of different types of health insurance, people employed as either SALES or SERVIC are disadvantaged groups with respect to health check-up.

As previously observed from the results of males and females in Table 3, health related variables such as SICKNUMB, STRESS, HLTHPRAC, HLTHEXCE, HLTHGOOD and HLTHFAIR are all highly significant and their estimates are positive. That is, regardless of the type of health insurance cover, individuals who are prone to illness as well as those who are conscious about their health conditions demand more health check-up than otherwise. Both objective and subjective measures of own health awareness motivate individuals to have the health check-up. Subjective information on health conditions, HLTHEXCE, HLTHGOOD and HLTHFAIR, seems to be an important factor in determining whether one takes the health check-up or not. That is, an individual who is subjectively keen about her own health condition is more willing to collect objective health information as well.

3 Health Check-up Results of National Health Insurance (NHI) by Gender

Now, let us compare the behavioral difference in the health check-up demand by males with the National Health Insurance and their female counterparts in Table 5.[34] A quick comparison of the results in the Table gives us an impression that many variables in both male and female regressions have similar signs on their estimated coefficients with varying sizes of their marginal effects. The female-specific MATERNITY variable is dominant and the marginal effect is −0.058. The variables on AGE and AGESQ are statistically significant in the female regression, but the marginal effects are quite similar between males' and females'. Among the other variables, those responsible for the differentials in the health check-up between males and females are, for example, WAGE, BREADWIN and PARTTIME in terms of the qualitative sign and PROPRIET, FAMILYWK, SIZE1, SIZE500, SIZE1000, PUBEMPLY and EDU in terms of the size of marginal effect. The former group has different signs on their estimated coefficients (and consequently their marginal effects) between males and females ; and the latter group has the same sign on the estimated coefficients but the magnitude of the respective marginal effects are quite different.

First, the variables of WAGE and BREADWIN are no longer one of the major deterrent factors for females with the NHI, but they are statistically significant for males with the NHI. For example, a male household head (BREADWIN) is likely to have his health check-up by about 6 percentage points higher than other males. Since the same variable for females is not significant, being a household head or not can be considered as a factor to differentiate the health check-up behavior between males and females. Similarly, we can consider the effect of WAGE as another factor. The male with higher wages is less likely to have his health check-up, ceteris paribus, than one with lower wages. However, the effect is not true for females, indicating that the hourly opportunity costs are not a major factor on the health check-up decision. Another factor responsible for these differentials is PARTTIME, whose effect is negative on the male health check-up while positive for the female behavior. We can consider that males with unstable jobs or those who are not fully committed to their job are less likely to have the health check-up ; while in the case of females, the opposite is true. For the latter, female part-time workers may find more time available for their health check-up.[35]

Second, let us see the variables with relatively large differences between males and females in their marginal effects. For example, regarding the type of employment status, male proprietors (PROPRIET), male family workers (FAMILYWK), males employed by small-sized firms (SIZE1) and male house worker (HUSWRKR) are less likely to have their health check-up than otherwise. Their marginal effects are from approximately −6 to −10 percentage points. Males and females who work at relatively large-sized firms such as SIZE500 and SIZE1000 are more likely to have the health check-up due to easier and better access to medical facilities than those working at smaller-sized firms or at home. The marginal effects of SIZE500 and SIZE1000 are 0.268 and 0.360 for males and 0.183 and 0.292 for females, respectively. Since a larger proportion of males are working at large-sized firms than females, the former have naturally the higher health check-up rate than the latter.

Third, the effect of education (EDU) on health check-up is negative for both males and females, while the marginal effect on the former (−0.265) is substantially larger than on the latter (−0.017) in absolute values.[36] Therefore, in the case of males, a one-percentage point increase in EDU causes a decrease in male health check-up by 0.265 percentage points.

Finally, the effect of place of residence on health check-up may seem puzzling at first. That is,

POP150 has a negative sign on the estimated coefficient, while the estimated coefficients of POP50 and POPCUNTY are positive, although the differentials in the marginal effects between males and females are negligible (see Table 5). The positive coefficients on POP50 and POPCUNTY, and the negative one on POP150 indicate that people living in less populated areas are more likely to have the health check-up than those in big cities. One probable explanation may be that the people in a county have generally less access to medical facilities when needed in comparison to people in big cities. Thus, the former are probably more willing to take the opportunity of health check-up when local governments or firms provide this service.

4 Health Check-up Results of National Health Insurance (NHI) by Age Group

In grouping males and females into several smaller age groups as respectively shown in Tables 6 and 7, the variable AGE seems to lose its significance for both males and females except for the 20-29 female age group in Table 7. This means that the age segmentation is too narrowed for the age evaluation. MARRIED is one of the major factors that differentiate health check-up behavior between younger and older age groups for both gender groups. For example, the sign is strongly negative for married women of the 20-29 age group, whereas it is positive for the 40-49 and older age groups. The sign is positive for the 30-39 and older male age groups. This is certainly indicative of the high costs these persons incur in having the health check-up when they are younger. MARRIED is not significant for females in the 30-39 age group: no significant differential exists between single and married women. Both have lower health check-up rates than any other age groups. On the other hand, married men aged 30 and over are more likely to have the health check-up more than their unmarried counterparts.

Again as frequently mentioned, it does matter what type of employment status is held, for both male and female NHI insurants. Those employed in firms with 100 workers or more (SIZE100, SIZE500, and SIZE1000) are generally more likely to have the health check-up than those with other types of employment status. These firm sizes are highly significant, as shown in both Tables 6 and 7. For example, the differences in the marginal effects (not shown in Tables) between females in SIZE1000 and those in SIZE1 under the different age group categories are: 0.372 (20-29), 0.321 (30-39), 0.289 (40-49), 0.163 (50-60), and 0.195 (61-64).[37] The corresponding vales for the male counterparts are: 0.404 (20-29), 0.512 (30-39), 0.429 (40-49), 0.454 (50-60), and 0.265 (61-64). These large differences in the marginal effects show that those employed by large-sized firms are much better off with regard to the health check-up than those working in smaller-sized firms.

According to occupation types, the coefficients of SALES and SERVIC are negative and significant for females in the 20-29, 30-39, and 40-49 age groups. The same job categories are also significant only for some of the male age groups. A reason why people in these occupations have less health check-up probably reflects the disadvantaged position they have in their working conditions with regard to accessing health check-up. The variables related to health conditions are highly significant across all age groups: SICKNUMB, STRESS, NOTVISIT, HLTHPRAC, HLTHEXCE, HLTHGOOD, and HLTHFAIR. Among these, the deterrent variable is consistently NOTVISIT. That is, if individuals are objectively in good health condition, they find it unnecessary to have the health check-up.[38] Other variables like EDU, LIFEINSU and POPCUNTY are statistically significant across the different age groups: the first two variables have negative effects on the health check-up; the last has a positive effect.

In sum, we find that the deterrent factors and motivating factors for the health check-up decision

by males and females are largely common and are also similar across different types of health insurance and different age groups. Their behavior is subject to the degree of accessibility, the amount of opportunity costs as well as subject to objective and subjective health conditions.

V Summary

This study aims to explain the behavior toward the demand for health check-up of the 20–64-year-old population in Japan. More specifically, there exist large differentials in the demand for the health check-up as differentiated by gender, by age and by types of health insurance. According to the sampled micro data from the *Comprehensive Survey of the Living Conditions of People on Health and Welfare* in 1995, the overall average health check-up rate is about 56 percent : 61 percent for males and 51 percent for females. Furthermore, the difference in the health check-up rate is more than 20 percentage points between National Health Insurance (NHI) insurants and those with Society-managed Health Insurance (SOCIHI) insurants. The difference is further widened to about 27 percentage points between the NHI people and those with Mutual Aid Associations Insurance.

In our analyses, we focused first on the impact of gender difference in the demand for health check-up behavior. Next, we specifically analyzed the differentials by the types of health insurance with an emphasis on people with NHI. Finally, the behavior of male NHI insurants was compared to that of female NHI insurants. By focusing our analyses narrowly toward the various categories of the population, our empirical results will have direct policy implications for the prevention of illness among the population in Japan. In knowing the cause-and-effect of the health check-up, policy makers as well as employers (or firms) can carefully implement specific and appropriate policies to promote people's health, and assist in containing their growing medical expenditures.

We apply a probit model not only to a gender-specific sample but also to a health insurance type specific and a NHI-classified age group-specific sample with regard to the individual decision on the health check-up. Among the socio-economic and demographic variables studied in the models, the major explanatory variables of interest are : age, gender, wage rate, health insurance coverage, affiliated firm size, and objective evaluations of the individual's health condition.

In our empirical results on the demand for the health check-up, most of the estimated coefficients of the aforementioned variables have the theoretically predicted signs and are highly significant. The estimated coefficients on age and age-squared are positive and negative, respectively. This reflects that the incentive for an individual to have the health check-up increases at a diminishing rate as her stock of health rises. In other words, an individual's stock of health accumulates as her age increases, and so does the loss of earning ability rise, thus the incentive for the health check-up rises. Gender also plays an important role for the individual's decision on the health check-up. Males are more likely to have their health check-up than females because of genetic and biological differences. Especially, females of the age group of 30–39 significantly decrease their demand for health check-up, which is probably due to the timing of marriage and maternity.

Normally, health check-up is a time-consuming health input. For this reason, the opportunity costs for giving up working hours or days should be considered a major determinant in the health check-up decision. The sign of the individual's wage rate is negative and highly significant and the wage elasticity of the health check-up is -0.10 for males and -0.04 for females. Family expenditures have positive effects on both males and females and their expenditure elasticity is nearly the same, about 0.01.

Health insurance coverage is one of the major factors analyzed in the models. We find the

significantly positive and robust effects of the Government-managed Health Insurance (GOVTHI), the Society-managed Health Insurance (SOCIHI), and the Mutual Aid Associations Health Insurance (MUTUHI) on health check-up. Our findings show that the higher the coverage of medical costs is, the more the individuals are willing to have the health check-up. Furthermore, based on the significantly positive effects of firm sizes with more employees on the health check-up for both males and females, larger-sized enterprises are witnessed to be more encouraging of their employees regarding the health check-up than the smaller-sized enterprises. This may be attributed to the fact that fringe benefits and working conditions for employees in the former are much more favorable than for those in the latter. Thus, in order to promote the health check-up among the population irrespective of gender, a public policy that improves the accessibility of health check-up and consequently lowers the opportunity costs of health check-up is needed.

For the effects of the individual's objective as well as subjective health conditions, the estimated coefficients are always statistically robust for both males and females. The more the number of illnesses are (the same applies to number of stressors), the more the individual is likely to have the health check-up. Furthermore, an individual who practices health promoting activities and is highly evaluative of her own health tends toward the health check-up. On the other hand, when an individual has had no experience of visiting clinics and hospitals for the past year, which here we consider as reflecting her higher stock of health, the individual has less incentive to have the health check-up, *ceteris paribus*.

Next, when we highlight the differentials of the health check-up by the types of health insurance such as NHI, GOVTHI, SOCHIHI and MUTUHI, the basic signs and significance in these models do not differ so much from the above results of the gender-specific model. However, an evaluation of each variable in its marginal effect does provide different aspects of its effect on the behavior of the health check-up. For example, the positive marginal effect of age for people with NHI is one third or one fourth of that for those employed in large-sized firms; persons who are proprietors, family workers or house workers, covered by the NHI, are the most disadvantaged groups with respect to accessibility to the health check-up. Therefore, the coverage of medical costs is another major factor that differentiates the health check-up behavior of the population.

Females of the maternity age have substantially low demand for health check-up across the different health insurance types. On the other hand, as far as the males are concerned, some of the major factors across the health insurance types are wages and being a breadwinner: the former have strong negative effects on the health check-up and the latter has positive effects. The negative wage elasticity is more elastic for male NHI insurants. In addition, a change in employment status that is reflected by a change in insurance coverage, e.g., SOCIHI to NHI, lowers the demand for the health check-up. It will be more natural to interpret the decrease as substantial changes in the opportunities of health check-up rather than a change in preference. Another major deterrent factor is job opportunity: once individuals are unemployed they decrease the demand for the health check-up. Females are more responsive to an incidence of losing jobs than males, shown by the reduction in the demand for the health check-up.

In our final models, we have examined factors that might cause the low demand for health check-up among male and female NHI insurants alike. In so doing, we group the males and the females into 10-year age ranges such as 20-29, 30-39, and so forth. In these analyses, the types of employment status, such as employment at large-sized firms, is a dominant factor that motivates both male and female NHI insurants to take the health check-up.

Occupation types, like sales and services, are also major factors, that, however, reduce the demand for health check-up among females in their 20s, 30s, and 40s. The effects are highly and positively significant for individual health conditions : sickness, stress, health practice, health excellent, and others.

As a concluding remark, the differentials in the demand for the health check-up are reflective of the opportunities in accessing the health check-up. Among the working population of the society, people employed by large firms or public institutions are a highly advantaged group, while those working in small firms or households are at a disadvantage with respect to accessibility. If the health check-up does play its role as a means of detecting illnesses and thus a means of preventive medical care, the individuals who take the health check-up are less likely to be caught off guard by serious illness. The high longevity rate of the Japanese may be attributed to the current health check-up program under the comprehensive health insurance system. Maintaining such a tendency among the population requires certain adjustments with regard to the prevalent preventive health care system with attention placed on the disadvantaged members of society.

Acknowledgements

This research was originally a part of the report, "Studies on Natural Increases in the Medical Expenditures," made by the Japanese Center for Economic Research (JCER) to the Institute for Health Economics and Policy. This paper is prepared for the Biwako Conference on Issues of Social Insurance of Japan held on the 13th through 15th of July 2000, and is an extension of the work presented at the joint meeting of JCER and the National Bureau of Economic Research (NBER) in Hawaii, U. S., 20-23 January 2000 ; as such, this study is similar in many aspects to the work presented in Hawaii and a part of this paper was presented at the 75 th Annual W. E. A. International Conference in Vancouver, B. C., Canada, 29 -June to 3-July 2000. This research is supported by the Japanese Center for Economic Research ; the Nomura Foundation for Social Science, the Japan Ministry of Education, Science, Sports and Culture (Grant # 11630034), and the Research Council Grant of Rutgers University, USA. The authors would like to thank Jane C. Buenaventura for her research assistance. The views presented here are those of the authors and do not necessarily represent those of the funding agencies nor those of the affiliated institutions.

Notes

1) For the detailed description, see the *Japan Statistical Yearbook 1999* (Statistic Bureau, Management and Coordination Agency, 1998, p. 616). The total number of correspondents in the 1995 Survey is 746,592 : N (aged 19 and less) =177,430 ; N (aged 20-64) =449,051 ; and N (aged 65 and more) =120,111.

2) In addition to these insurance systems, there is the health service system for the elderly aged 70 or more, who receive medical care services at minimum cost. The detailed outline of Japan's Medical Care Security System is described in the *Outline of Social Insurance in Japan 1998* (Social Insurance Agency, Government of Japan, 1999), which this section summarizes.

3) The number of employees is not rigid in practice.

4) The contribution rate levied on basic wages of employees varies among different types of health insurance : half of the total contribution rate (8.5%) of the Health Insurance managed by Government is paid by the employers (4.25%) ; employees under the Society-managed Health Insurance are responsible for 3.658% of their total contribution rate (8.394%), the rest (4.736%) being paid for by their employers. National government employees, on the other hand, pay half of their total contribution rate (7.8%). Source : *Outline of Social Insurance in Japan 1998* (Social Insurance Agency, Government of Japan, 1999), pp. 140-143.

5) This health check-up is often extended to the

employee's spouse, parents and children.

6) The Institute of Labor Administration (1998), *Situations of Fringe Benefits*, pp. 278-285 and pp. 334-347. The survey period was from October 19 to December 28 in 1995.

7) All dollar values in this paper are calculated based on the exchange rate of \$1=100 yen, for brevity. We note that, according to OECD HEALTH DATA 98, per capita health expenditures incorporate the purchasing power parity (PPP), \$1=195.35 yen, in calculation. However, ours use \$1=100 yen for two reasons : first, the dollar values in PPP seem to underestimate the reality in Japan ; and second, our dollar values can be easily translated into the PPP values if those values are halved.

8) Spouses of employees, covered under the Employees' Health Insurance as dependents, may receive this service upon their request to the corresponding local government.

9) The following items of health check-up and the corresponding fees vary with the locality involved, reflecting the budgetary constraints of their respective local governments.

10) One of the possible reasons why persons covered by the Mutual Aid Associations Health Insurance have higher health check-up rates maybe due to the fact that those working at schools or universities have medical offices at the work place.

11) We note a similar dip with Japanese female labor force participation rate : 73.4% (ages 20-24), 68.2% (25-29), 56.2% (30-34), 62.3% (35-39), 70.9% (40-44), and 72.2% (45-49), as of 1997 : Government of Japan, Ministry of Labor (1999), *Whitepaper on Female Labor*, F11.

This dip is a typical phenomenon of female labor force participation in Japan.

12) Difference in rate of time preference between married and single women may be also another explanation. However, the health check-up rate is reversed between them at the late age of 61-64. Thus, a consistently low rate of time preference for single women may not be a good explanation.

13) A firm with over 1,000 workers usually provides a Society-managed Health Insurance.

14) Normally in a text like Silberberg (1990), wealth rather than earning capacity is used in a typical uncertainty model. However, since we are applying the theory of household production to the model, we prefer the use of "earning capacity," which is assumed to be reflecting monetary units like wealth. This simple application of the theory of insurance under uncertainty is based on Pauly (1989), pp. 309-319, and Silberberg (1990), pp. 445-447.

15) Here, we avoid putting subscript i to represent the individual, for brevity.

16) We implicitly assume here that there is an accumulation of health stock up to a certain age.

17) For example, the major diseases among the fifty- and sixty-year old Japanese are diseases of the digestive system, circulatory system, musculoskeletal system and connective tissue, and nervous system and sense organs (*Japan Statistical Yearbook 1999*, pp. 670-671).

18) About 49% of patients in large-sized hospitals wait for at least an hour and a half ; and about 15% wait for more than 3 hours. In medium-sized hospitals, those who wait for more than an hour and a half account for about 44%, and account for 28% in small-sized hospitals. In both hospitals, the patient rates for those who wait for more than three hours are 17.2% and 15.6%, respectively (*Movements in National Sanitation*, 1999. p. 84). However, medical examinations in hospitals last very short : almost 64% of patients in large-sized hospitals take only 10 minutes or less for their examinations, and 18% take less than 3 minutes. About 61% and 57% of patients, respectively in medium-sized and small-sized hospitals, take less than 10 minutes or less for their medical examinations.

19) Here, we change our notations, such that $1-\pi=\pi_1$ and $\pi=\pi_2$.

20) According to Ehrlich and Becker (1972), the left-side expression in equation (11) in our presentation is viewed as the slope of the production transformation curve ; and the right side is the slope of the indifference curve of S_1, S_2. Hence, both sides must be equal in equilibrium for $h>0$.

21) The reduction in this context might be due to "self-protection." In Ehrlich and Becker (1972), "... self-insurance [is] a reduction in the size of a loss, and self-protection [is] a reduction in the probability of a loss (p. 633)."

22) Hereafter, we assume that this condition holds.

23) The presentation of this probit model is from Gujarati (1995, pp. 563-564).

24) As we mentioned earlier, the variables pertaining to individuals in this study are all from the

Comprehensive Survey of the Living Conditions of People on Health and Welfare in 1995.

25) In our regression analyses, we grouped the sample population ages 20-64 into different categories by health insurance and also by gender, since we focus our study mainly on differentials in the demand for health check-up.

26) In Table 3 as well as in other Tables, when the sign of t-statistic is negative and the estimated coefficient is 0.000, the estimated coefficient is in fact negative. The reported value is simply due to the text format used.

27) These marginal effects are based on the values without the AGESQ term. The inclusion will give the following formulas: the marginal effect for males $=0.015-2\times0.0001$AGE, and that for females $=0.011-2\times0.00005$AGE.

28) The marginal effect of discrete variable x_i in this paper is obtained by the following:

$$\frac{\partial HCHECKUP}{\partial x_i}=F(x_i=1, X_j)-F(x_i=0, X_j), \text{ where } F(\cdot)$$

is the cumulative distribution function and X_j is a vector of all other variables, $i\neq j$.

29) The omitted dummy variable for firm size is company directors.

30) The difference in the marginal effects between SIZE1000 and HUSWRKR (or NOJOB) is about 0.25 for males.

31) The HLTHPRAC variable is the number of health-related daily practice (e.g., eating regular meals, nutritiously balance meals and not-too-salty meals, having physical exercise, adequate hours of sleep, so on).

32) These two variables are two of the few aggregate variables in the models.

33) The definitive sign must await further study using micro data on education variable.

34) The gender-specific results of other health insurances are also estimated, but they are not reported for brevity and are available upon request from the authors.

35) Although the variable of firm size is controlled in the regression, when large-sized firms hire female part-time worker, they have more and better opportunities for their health check-up than those in smaller-sized ones.

36) The EDU variable is a continuous aggregate variable on the prefectural level.

37) The values are the probabilities of health check-up for individuals in SIZE1000 in comparison to those in SIZE1. The marginal effects are not reported in Tables 6 and 7 for brevity.

38) One may say that the relationship between having the health check-up and NOTVISIT is not causal, but both are in fact similar variables. That is, one who does not want to visit medical institutions does not have their health check-up anyway. We have few arguments to defend the inclusion of the variable in the models. First, if not-health-check-up means not-visit-hospital, then the variable should have a nearly perfect prediction of the health check-up behavior but that is not the case here. Second, the t-value of NOTVISIT is not always overwhelming. Lastly, and probably more importantly, NHI insurants usually have the health check-up at health centers, which are not considered medical institutions.

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(やまだ・ただし 筑波大学教授)
(やまだ・てつじ Tetsuji YAMADA : Prof. of Rutgers University, The State University of New Jersey)