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Author: Tadashi Yamada, Tetsuji Yamada

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The Demand for Health Checkups under Uncertainty

Tadashi Yamada and Tetsuji Yamada

10.1 Introduction

Good health is by itself of great value. It enhances market earnings by increasing the number of healthy days an individual has available for work (Grossman 1972) and increases nonmarket productivity, allowing more time for household production (Becker 1976). Health checkups help to secure and maintain good health. However, the *1995 National Survey of Life* (*Kokumin Seikatsu Kiso Chosa* in Japanese; Statistics and Information 1998), administered by the Japanese government, shows that only about half of Japan's population undergoes health checkups. The reasons behind the low demand for health checkups, despite Japan's comprehensive health care system, are analyzed in this paper.

There are at least two additional benefits of health checkups that will be important in the analysis of demand for these checkups. First, a checkup will likely give an individual a more objective diagnostic health analysis, in addition to his or her own subjective evaluation of health, made under un-

Tadashi Yamada is professor of economics in the Institute of Policy and Planning Sciences at the University of Tsukuba. Tetsuji Yamada is professor in the Department of Economics–Camden College of Arts and Sciences at Rutgers, The State University of New Jersey.

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certainty. Second, health checkups lead to further demand for preventive medical care when necessary. Early medical care often curtails serious illness. In this respect, the demand for health checkups differs from the demand for health. The former is a derived demand, whereas the latter is a final demand. That is, health checkups appear in the demand for health, which in turn appears in the individual utility function. However, similar socioeconomic and demographic factors appear as determinants in both reduced-form demand functions (Grossman 2000).

In particular, individuals demand more health information as age increases (Kenkel 1990). Time costs are also major determinants of the demand for health checkups, which exhibits a larger time-price elasticity than the demand for other medical inputs (Phelps and Newhouse 1974; Coffey 1983). Income has a positive effect on the demand for preventive medical care (Kenkel 1994). A better knowledge of one's own health also increases the demand for preventive medical care (Hsieh and Lin 1997). However, better health gives individuals less incentive to collect health information. Furthermore, lack of knowledge about health leads individuals to adopt unhealthy consumption patterns (Kenkel 1991). Thus, uncertainty plays an important role in determining the demand for health checkups, as well as the demand for health itself (Arrow 1963).

This study focuses on the demand for health checkups rather than the demand for health. Its purpose is to clarify the reasons behind the low demand for health checkups in Japan. There are few empirical studies that analyze this issue using microdata from the *National Survey of Life* (Statistics and Information 1998). This study takes an original sample of about 630,000 observations from the twenty-to-sixty-four age group. Of this number, we focus on the thirty-to-sixty age group because this group is more homogeneous, consisting mainly of working people.

We find a gender differential in the demand for health checkups even after controlling for other socioeconomic and demographic characteristics. This differential tends to disappear as age increases. Age is a major factor in determining the demand for health checkups within the thirty-to-sixty age group, but it is less significant within smaller age groupings. The type of health insurance coverage and employer size are also robust factors that affect an individual's health checkup demand. Finally, we identify a strong negative correlation between the health checkup rate and the probability of becoming ill, as well as the duration of hospitalization.

This paper is organized as follows. Section 10.2 provides an overview of the health checkup system in Japan. Section 10.3 presents statistics on health checkups, based on the aforementioned survey. Section 10.4 presents a theoretical model with a comparative static analysis of the demand for health checkups and describes the variables of interest in this study. Section 10.5 reports the empirical results, and section 10.6 concludes.

10.2 An Overview of the Health Checkup System in Japan

Japan's medical insurance system is a comprehensive system covering the entire population through employees' health insurance, seamen's insurance, and national health insurance.[1] There are three types of employees' health insurance: (a) health insurance managed by associations (provided by employers with 700 employees or more);[2] (b) health insurance managed by the government (provided by employers with fewer than 700 employees); and (c) mutual aid associations insurance, covering public employees and teachers and personnel in private schools. Employees' health insurance covers 80 percent and 70 percent of medical costs for insured persons and their dependents, respectively. National health insurance (NHI) is a community-based insurance plan for local residents who are not covered by employees' health insurance. It pays for 70 percent of medical costs incurred by all insured persons.[3]

In March 2000, 15.2 million insured individuals and 16.5 million dependents were covered by health insurance managed by associations. An additional 19.5 million insured individuals and 17.3 million dependents were covered by health insurance managed by the government. The third and final employees' health insurance program, mutual aid associations insurance, insured 4.5 million individuals and 5.6 million dependents. There were 0.08 million individuals and 0.14 million dependents covered by seamen's insurance. Finally, 47.6 million persons were insured by NHI (Health and Welfare Statistics Association 2001).

Anybody can have a health checkup regardless of his or her type of health insurance. This service is provided for employees at their work sites or at hospitals and clinics in the vicinity of their workplace. Persons covered by NHI who are not in school receive notices about health checkups from their local governments. They can receive their health checkups at local health centers, hospitals, and clinics. Students in this program receive their health checkups at their school, college, or university.

There are three types of health checkups provided by firms: compulsory health checkups required by law, recommended health checkups, and discretionary health checkups. A general health checkup is usually compul-

1. In addition to these insurance systems, there is another system for individuals aged seventy and older, who receive medical care services at minimum cost. A detailed outline of Japan's Medical Care Security System is contained in the *Outline of Social Insurance in Japan 2000* (Social Insurance Agency, Government of Japan, 2001).

2. The number of employees is not rigid in practice.

3. The contribution rate levied on an employee's basic wages varies across types of health insurance. Employees covered by health insurance managed by associations are responsible for half the contribution rate (not to exceed 4.5 percent), of the set contribution range of 3.0 to 9.0 percent, with the remainder paid by their employers. Employers and employees evenly split the 8.5 percent contribution rate for health insurance managed by the government. National government employees, on the other hand, pay 4.05 percent of their 8.10 percent contribution rate (Social Insurance Agency, Government of Japan, 2001).

sory prior to the commencement of employment, and again once every year throughout the duration of employment. It includes the following items: (a) report of medical history; (b) self-evaluation and objective evaluation of medical symptoms; (c) measurement of height, weight, hearing, and vision; (d) chest x-ray radiography; (e) measurement of blood pressure; (f) urine examination; (g) anemia testing; (h) analysis of liver function; (i) testing of blood lipids; (j) testing of blood sugar; and (k) electrocardiogram.

Depending upon an employee's job type, employers must provide items in addition to this compulsory list. For example, employers must provide a health checkup once every six months to employees working at night, having health-hazardous jobs, or dealing with poisonous chemicals in the workplace. Employers must give the results of these health checkups to the district branch of the Labor Standards Inspections Office. In addition to these compulsory health checkups, firms often provide their employees with another type of health checkup as a fringe benefit: half-day, one-day, or two-day annual hospital checkups in order to promote the employee's health and to find sickness at an early stage.[4] This type of medical service for employees, called *Nin-gen Dock,* is not covered by employees' health insurance. According to *The Situations of Fringe Benefits* (Institute of Labor Administration 1998), 81 percent of 5,000 firms surveyed (sampled from all industries) subsidize 70 percent or more of the medical costs incurred from in-hospital comprehensive health checkups.[5] On average, employers pay $350 for such exams, but coverage ranges from $100 to $900.[6] This subsidy is provided by 89 percent of firms with 3,000 employees or more, 84 percent of firms with 1,000–2,999 employees, and 74 percent of firms with fewer than 1,000 employees.

Although employers are only legally required to contribute half of the insurance payments for their employees, the survey shows that firms often pay more. Although 84 percent of firms utilizing health insurance managed by the government pay half the rate, 86 percent of firms with health insurance managed by associations pay more than half the rate. Also, 95 percent of firms with more than 3,000 employees pay more than half of the contribution rate.

By law, an employer or establishment with more than 1,000 employees must have its own in-house industrial doctor. Employers dealing with

4. This health checkup benefit is often extended to the employee's spouse, parents, and children as well.

5. Institute of Labor Administration (1998, 278–85 and 334–47). The survey period was from 19 October to 28 December 1995.

6. All dollar values in this paper are calculated using an exchange rate of 1 dollar = 100 yen, for simplicity. Although a purchasing power parity (PPP) rate of $1 = ¥195.35 is used by the Organization for Economic Cooperation and Development (OECD; 1998), we do not believe that this rate reflects reality in Japan. Moreover, the dollar values given can be easily translated into PPP dollars if the values are halved.

health-hazardous or poisonous chemicals at the work site must provide an on-site doctor when 500 or more workers are employed. Firms with fifty or more employees must have a contracted medical practitioner or doctor that acts as an industrial doctor, overseeing the employees' health condition. Furthermore, firms must hire certified sanitary administrators (SAs). The number of SAs varies according to the size of the establishment: one SA for a firm of 50–200 employees, two SAs for a firm of 201–500 employees, three SAs for a firm of 501–1,000 employees, four SAs for a firm of 1,001–2,000 employees, five SAs for a firm of 2,001–3,000 employees, and six SAs for a firm of 3,001 or more employees. These regulations indicate that employees in larger firms enjoy better health benefits, including having health checkups at their place of work.

Similarly, NHI also provides various types of health checkups to local residents who are not covered by employees' health insurance or other types of health insurance.[7] Generally, the local government notifies residents about the schedules for health checkups. These health checkup periods are scattered throughout the year to accommodate the seasonal employment patterns of residents. Residents usually go to a local health center for their health checkups, but they must go to hospitals and clinics for some types of medical checkups. They pay the minimum fee according to the type of health checkup they have.

The types of health checkups provided by local governments are as follows: (a) group health checkups at local health centers and individual visits to hospitals or clinics, and (b) comprehensive medical health checkups in hospitals (i.e., the *Nin-gen Dock*). The former includes the basic health checkup items listed 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).[8] The latter type of checkup includes the basic health checkup items plus other services depending on the length of hospital stay. The subsidies offered by local governments are, for example, \$175 for a general medical examination (out-of-pocket expenses are about \$190; that is, the total costs are about \$365), \$250 for a brain examination (out-of-pocket expenses are about \$274), and \$375 for a comprehensive examination (i.e., general plus brain examination; out-of-pocket expenses amount to about \$410). The above-mentioned health checkups have age restrictions. For instance, the general medical examinations are for people aged thirty or higher, and the brain and comprehensive examinations are for those aged forty or higher. These examples also indicate that

7. Spouses of employees who are covered under employees' health insurance as dependents may receive this service by submitting a request to the corresponding local government.

8. The items included in the health checkup and the corresponding fees vary by locality, reflecting the budgetary constraints of local governments.

employees in larger firms enjoy better and more varied benefits than do those in smaller firms or the self-employed.

The next section provides a statistical overview of the health checkup program in Japan.

10.3 Health Checkup Statistics

In the preceding section, we discussed health checkups and coverage for these checkups under different types of health insurance. Clearly, the Japanese have adequate opportunity to undergo health checkups. Here we report on how many people aged twenty to sixty-four in Japan have health checkups, based on statistics from the *1995 National Survey of Life* (*Kokumin Seikatsu Kiso Chosa,* hereafter the Survey). The following summary of the Survey is quoted from the *Japan Statistical Yearbook 1999* (Statistics Bureau 1998).

> This Survey has been conducted by the Ministry of Health and Welfare every three years, since 1986. The Survey is a sampling survey covering all households and their household members within the stratified sample districts chosen at random from the enumeration districts of the 1990 Population Census, and is conducted by enumerator's interview method through the channels of prefectures, designated cities and health centers. The Survey was taken as of 1 June for about 270,000 households and about 800,000 household members in 5,100 districts, excluding one prefecture, Hyogo (616).

Table 10.1 gives the proportion of people reporting health checkups, by gender and age group. The total sample size is 449,051, of which 219,983 are male respondents and 229,068 are female respondents. These proportions reveal at least three noteworthy characteristics. First, the overall average proportion of individuals having health checkups is 0.557. Second, the overall proportion of males having health checkups is 0.607, which is about 10 percentage points above the 0.509 proportion of females. This difference narrows as age increases, excepting the thirty-to-thirty-nine age group (see fig. 10.1). Third, the health checkup rate peaks with the fifty-to-sixty age group for both males and females. A possible explanation for why the health checkup gender differential is widest in the thirty-to-thirty-nine

Table 10.1 **Health Checkup Rates by Gender and Age Group**

		Age					
	N	20–64	20–29	30–39	40–49	50–60	61–64
Total	449,051	0.557	0.457	0.521	0.597	0.620	0.585
Males	219,983	0.607	0.487	0.630	0.652	0.653	0.583
Females	229,068	0.509	0.429	0.415	0.543	0.590	0.587

Source: 1995 National Survey of Life, Statistics and Information (1998).

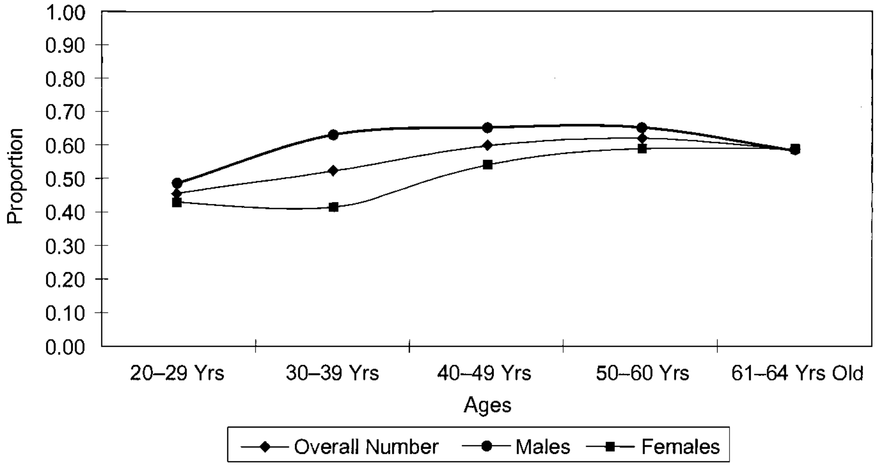

Fig. 10.1 Health checkup: Total number, age, and gender

Table 10.2 Health Checkup Rates by Type of Insurance Coverage

		Age					
	N	20–64	20–29	30–39	40–49	50–60	61–64
Health insurance managed by associations	106,593	0.647	0.550	0.610	0.704	0.733	0.666
Health insurance managed by the government	145,452	0.582	0.474	0.532	0.630	0.668	0.654
Mutual aid associations insurance	49,980	0.692	0.563	0.648	0.755	0.775	0.690
National health insurance	141,424	0.419	0.269	0.311	0.396	0.490	0.550
Seamen's insurance	1,515	0.576	0.443	0.517	0.568	0.682	0.500
Other health insurance	4,087	0.404	0.354	0.464	0.407	0.400	0.404

Source: 1995 National Survey of Life, Statistics and Information (1998).

age group is that females leave their place of employment to get married and start a family in this age range. Thus, they may have fewer opportunities to have their health checked. Most probably, the notification for the checkups now comes from their local government as opposed to from their workplace. A similar phenomenon occurs with males. There is an abrupt decline in the proportion of health checkups from the fifty-to-sixty to sixty-one-to-sixty-four age groups. This probably happens because sixty is the typical age of retirement. However, we still need to know why the proportion of health checkups increases as age increases. We attribute this phenomenon partially to the depreciation of health stock.

To examine whether there are differentials in the health checkup rate across types of health insurance, we show the checkup rate for each type of insurance coverage by age group in table 10.2 (graphed in fig. 10.2). In almost all age groups, the health checkup proportion is highest for mutual

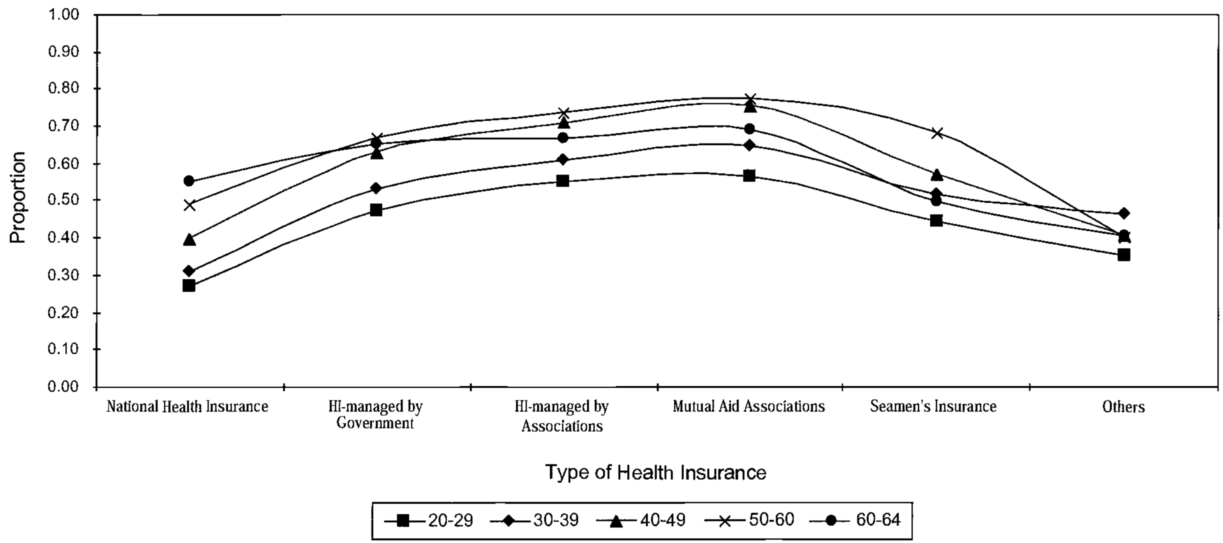

Fig. 10.2 Health checkup: Insurance coverage

aid associations insurance and second highest for health insurance managed by associations. A reason for these high health checkup rates is that employees covered by either of these health insurance plans enjoy more and better fringe benefits, and, with easier access to health checkups, they incur fewer costs. As noted in section 10.2, firms with 1,000 or more employees must have an industrial doctor and medical assistants such as nurses on site. By comparison, smaller firms may provide fewer medical facilities and services at their work sites, and they may not want employees to leave their jobs simply for health checkups. The employees themselves may face peer pressure not to take a day off for a health checkup. In response to this problem, branches of the Supervision of Labor Standards work to facilitate the provision of checkups, both by informing employers of their necessity and by parking medical vehicles with x-ray radiation equipment at or near work sites. As in table 10.1, the health checkup rate peaks in the fifty-to-sixty age range.

To confirm the existence of opportunities for health checkups among employees in relatively large establishments, we present health checkup rates by employment status in table 10.3. Again, we find that employees in larger

Table 10.3 Health Checkup Rates by Employment Status

		Age					
	N	20–64	20–29	30–39	40–49	50–60	61–64
Self-employed with employees	16,137	0.412	0.269	0.313	0.389	0.456	0.504
Self-employed without employees	25,831	0.447	0.256	0.309	0.412	0.481	0.555
Family workers	22,649	0.416	0.212	0.296	0.412	0.529	0.595
Company and association workers	15,325	0.617	0.463	0.540	0.608	0.682	0.689
Employed in a general enterprise with 1–4 employees	10,965	0.377	0.250	0325	0.427	0.477	0.492
Employed in a general enterprise with 5–29 employees	51,347	0.533	0.410	0.516	0.582	0.616	0.625
Employed in a general enterprise with 30–99 employees	45,075	0.660	0.549	0.650	0.705	0.735	0.726
Employed in a general enterprise with 100–499 employees	41,724	0.732	0.638	0.740	0.778	0.789	0.749
Employed in a general enterprise with 500–999 employees	13,063	0.750	0.661	0.748	0.814	0.815	0.748
Employed in a general enterprise with 1,000+ employees	63,248	0.803	0.709	0.810	0.853	0.862	0.811
Public employees	26,326	0.810	0.695	0.798	0.857	0.857	0.781
Monthly part-time workers	10,381	0.549	0.348	0.470	0.606	0.456	0.689
Daily part-time workers	2,980	0.448	0.262	0.352	0.492	0.529	0.602
Household workers	2,465	0.432	0.157	0.306	0.473	0.519	0.531
Others	5,470	0.459	0.285	0.388	0.501	0.561	0.575
Not working	123,065	0.409	0.265	0.286	0.424	0.528	0.552

Source: 1995 National Survey of Life, Statistics and Information (1998).

firms have very high health checkup rates. For example, employees in enterprises with over 1,000 workers have the highest rate among the general enterprises (that is, private firms); the proportion of workers having health checkups is 80 percent or more except for the twenty-to-twenty-nine age group. The overall rate for all age groups is highest for public employees (0.810). In addition, for most types of employees, the highest health checkup rates occur in the forty-to-forty-nine and fifty-to-sixty age groups, as shown in figure 10.3. However, among self-employed, part-time, and household workers, the proportion of health checkup recipients is largest for the sixty-one-to-sixty-four age group. In addition to facing a higher risk of sickness, older individuals may have more time available to go for checkups.

Table 10.4 and figure 10.4 show health checkup rates by industry and age group. Note that security employees have the highest overall health checkup rate: 0.752. This high rate reflects the occupational requirement mentioned earlier: People who work at night must have health checkups twice a year. Hence, the law enforcement industry is highly effective in encouraging its employees to have health checkups.

Finally, we examine the attitude of people who have symptoms of sickness or who are regularly visiting the hospital toward health checkups. We hypothesize a priori that these people, who are aware of their sickness or who are at high risk of becoming sick, are more likely to go for a checkup. Table 10.5 provides a summary of the evidence on this assumption. In the twenty-to-sixty-four age group, the overall difference in health checkup rates between people with no symptoms (symptom = 0) and people with symptoms (symptom = 1) is nearly 10 percentage points. The age subdivisions reveal that the differential increases with age.

In contrast, gender differences in health checkup rates for both the symptomatic and the symptom-free groups are virtually eliminated by age sixty-one to sixty-four. We cannot satisfactorily explain why the difference between the gender groups is so large regardless of whether symptoms are present. For instance, there is a 20 percentage point difference between males and females in the thirty-to-thirty-nine age group and a 10 percentage point difference in the forty-to-forty-nine age group. Females always have lower health checkup rates than males until the age of sixty. Attributing these gender differences solely to employment differences is both too hasty and too demanding of employment differences. At this point, it seems more reasonable to assume that men and women have different attitudes toward health risks. Similar results are obtained for hospital visits.[9]

The findings from this *National Survey of Life* sample of approximately 450,000 people, aged twenty to sixty-four, may be summarized as follows:

1. Males and females have distinctly different attitudes toward health checkups.

9. This similarity should be obvious since hospitals diagnose the symptoms.

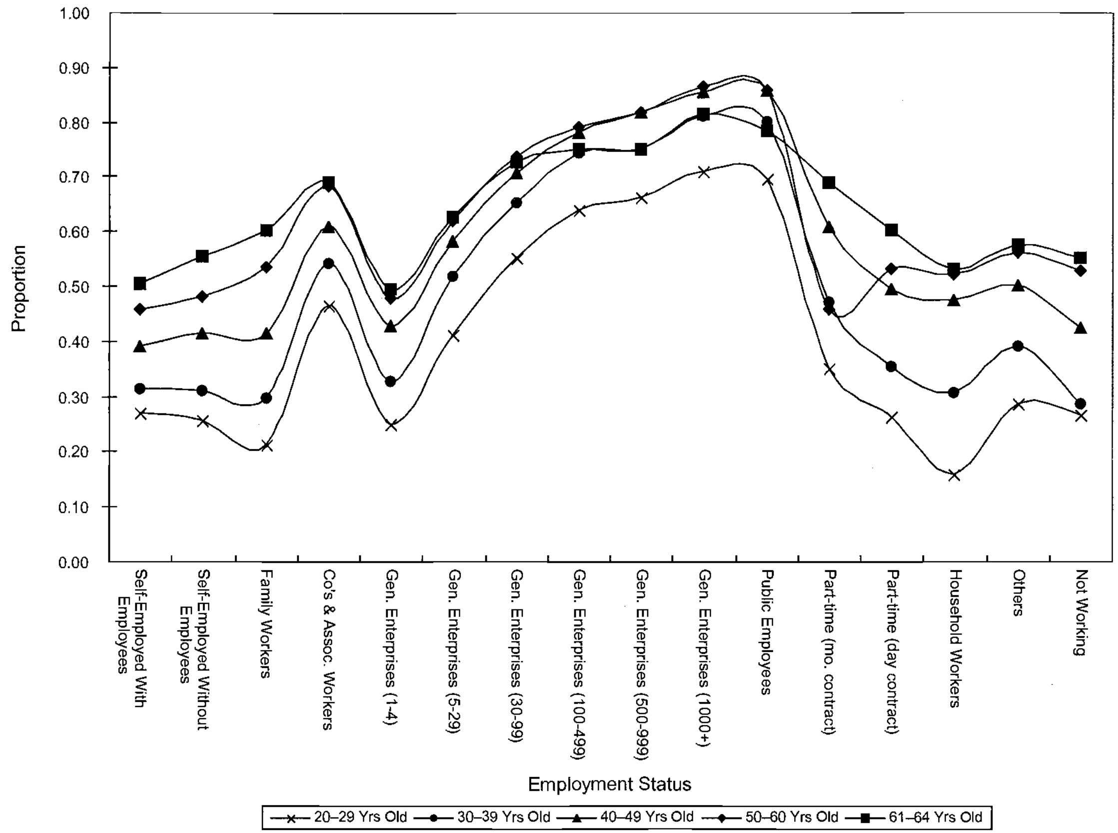

Fig. 10.3 Health checkup: Employment status (by age)

Table 10.4 Health Checkup Rates by Industry

		Age					
	N	20–64	20–29	30–39	40–49	50–60	61–64
Professional	49,819	0.659	0.594	0.665	0.693	0.696	0.610
Administrative	21,265	0.717	0.529	0.652	0.737	0.754	0.726
Clerical	55,745	0.657	0.590	0.683	0.729	0.745	0.707
Sales	36,534	0.517	0.452	0.505	0.541	0.549	0.550
Service	32,804	0.526	0.421	0.490	0.549	0.597	0.600
Security	3,757	0.752	0.639	0.745	0.818	0.774	0.715
Agriculture	13,811	0.567	0.316	0.391	0.533	0.617	0.634
Forestry	758	0.589	0.333	0.390	0.541	0.655	0.694
Fishery	2,174	0.453	0.307	0.328	0.446	0.544	0.500
Transportation and communication	10,796	0.653	0.503	0.633	0.679	0.733	0.680
Craftsmen[a]	83,173	0.602	0.528	0.588	0.623	0.642	0.614
None of the above	4,603	0.535	0.440	0.520	0.542	0.587	0.580
Unknown	133,994	0.423	0.286	0.314	0.445	0.524	0.560

Source: 1995 National Survey of Life, Statistics and Information (1998).

[a]Craftsmen include workers and laborers in mining, construction, and production processes as well as craftsmen.

2. As people grow older (e.g., from age group forty to forty-nine to age group sixty to sixty-four), they become more health conscious.

3. People with health insurance managed by associations or mutual aid associations insurance have more health checkups than those covered by other types of health insurance.

4. Employees in relatively large establishments (e.g., with 500 workers or more) have better access to health checkups. This is also true for public employees.

5. People employed in security-related jobs have the highest health checkup rate.

6. People with symptoms of illness undergo health checkups more often than do people without symptoms.

7. Regardless of whether they display symptoms of illnesses (visit the hospital or not), males usually have health checkups more frequently than do females.

These observations are incorporated in the theoretical model in the next section.

10.4 Theoretical Model

10.4.1 Model

As noted above, only 56 percent of twenty- to sixty-four-year-old Japanese had health checkups in 1995. Nearly half the population did not un-

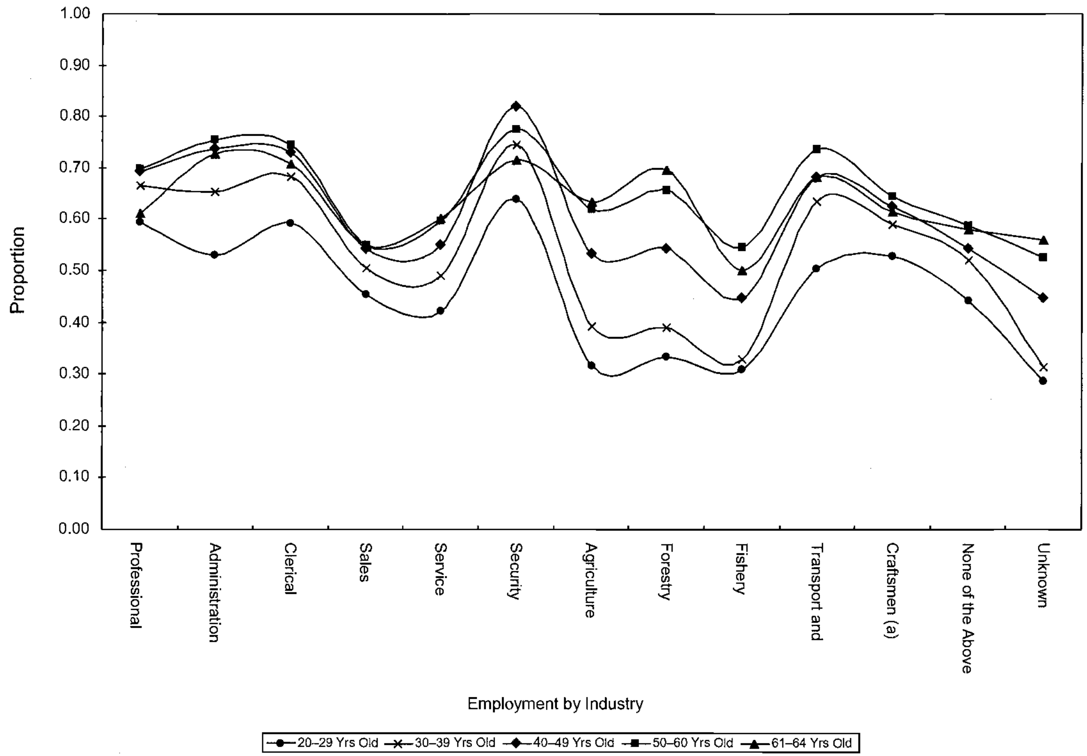

Fig. 10.4 Health checkup: Employment by industry and age

Table 10.5 Health Checkup Rates by Symptoms and Gender

		Age					
	N	20–64	20–29	30–39	40–49	50–60	61–64
Symptoms = 0							
Total	339,013	0.534	0.454	0.515	0.581	0.585	0.524
Males	171,577	0.586	0.481	0.622	0.636	0.621	0.524
Females	167,436	0.480	0.426	0.405	0.526	0.549	0.523
Symptoms = 1							
Total	110,038	0.629	0.476	0.549	0.652	0.685	0.655
Males	48,406	0.683	0.536	0.676	0.712	0.717	0.654
Females	61,632	0.586	0.444	0.456	0.599	0.658	0.655

Source: 1995 National Survey of Life, Statistics and Information (1998).

dergo a health checkup despite the fact that these checkups can identify illnesses at early stages. There are a number of possible explanations for this phenomenon. One explanation is that most people are risk lovers, but this seems unlikely. Another is that most people are risk averse but feel they have adequate knowledge concerning their health status; thus, the marginal benefits of having a health checkup are lower than the costs. There are too many other possible explanations to mention. However, it is clear that uncertainty about one's health and the incidence of disease plays an important role in the decision to have a checkup. Generally, a person can prevent future financial loss and psychological burdens by having more and better information with regard to his or her present health status. This kind of information could be provided by a health checkup.

In this section, we present an application of the theory of insurance under uncertainty. This theory aims to explain an individual's choice of whether to have a health checkup in response to changes in exogenous factors.

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

$$U = U(S_1, S_2; \pi_1, \pi_2). \tag{1}$$

Utility is defined over the contingent earning capacity (S_1, S_2).[10] The corresponding probabilities, π_1 and 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.[11]

Suppose there is an event S_1 that an individual faces with probability π_1.

10. Wealth, rather than earning capacity, is typically used in uncertainty models (e.g., Silberberg 1990). However, since we apply the theory of household production to the model, the use of earning capacity is appropriate and can be assumed to reflect all monetary measures, including wealth.

11. This simple application of the theory of insurance under uncertainty is based on Pauly (1989, 309–19) and Silberberg (1990, 445–47).

If S_1 occurs, the individual maintains his initial health-related earnings endowment S_0 by incurring the cost of preventive activities h, which we take to be a health checkup.[12] In addition, the individual pays the insurance premium (or tax) P required by his type of health insurance, whose purpose is to protect him from a loss of his earnings endowment S_0 due to sudden illness. Thus, S_1 is defined as

(2) $$S_1 = S_0 - h - P.$$

The individual faces a second event S_2 with probability π_2, in which he suffers a loss L of his earnings capacity. We assume that the magnitude of the loss increases with the individual's age A. That is, the individual's opportunity costs increase (at a diminishing rate) as age increases.[13] In addition, the stock of health eventually depreciates with age. Finally, we also assume an additional factor H as an argument of L. The individual may engage in some health-promoting activities H to increase his health stock HS. Loss L is defined as follows:

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

In equation (3), the size of L depends on the type of illness.[14] Different illnesses are associated with different measurable symptoms (with some overlap) such as high blood pressure, high cholesterol, proteinuria, and high white blood cell count. Each symptom s_j is associated with a particular illness and, hence, with a particular loss L_j. Having a health checkup is influenced by subjective or objective symptoms or both, so that

(4) $$h = h(s_j), j = 1, \ldots, n.$$

If symptoms have a probability distribution $\pi_j(s_j)$, then having a health checkup is an inverse function of symptoms,

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

Therefore, the relationship between the health checkup h and loss L_j is

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

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

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

12. For simplicity, we omit the individual subscript i and also assume the individual to be male.

13. The implicit assumption here is that health stock accumulates up to a certain age.

14. For example, the major diseases among fifty- to sixty-year-old Japanese are diseases of the digestive system, circulatory system, musculoskeletal system and connective tissue, and nervous system and sense organs (Statistics Bureau 1998, 670–71).

Finally, if event 2 occurs, the individual receives medical care, which has the effect of augmenting earnings capacity by M. However, obtaining medical care entails some costs, such as the discomfort associated with long waits in clinics and hospitals.[15] This "psychological burden" should be included in the cost calculation as $-gM$, where $0 < g < 1$. Now, event 2 can be defined in terms of costs and benefits in money-equivalent units:

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

Finally, π_1 and π_2, the probabilities attached to events 1 and 2, are functions of an individual's age A.[16] As an individual ages, he becomes more susceptible to illness. We express the individual's preferences over uncertain prospects using an expected utility function, or a Von Neumann-Morgenstern utility function, as follows:

$$\begin{aligned} \text{EU} = {} & [1 - \pi(A)]U(S_0 - h - P) \\ & + \pi(A)U[S_0 - h - P - \pi^*(h)L(A, H) + (1 - g)M] \end{aligned} \tag{9}$$

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

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

or

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

where

$$\begin{aligned} x &\equiv S_0 - h - P, \\ y &\equiv S_0 - h - P - \pi^*(h)L(A, H) + (1 - g)M, \\ U_x &= \partial U / \partial x > 0, \\ U_y &= \partial U / \partial y > 0, \\ \pi_h^* &= [\partial \pi^*(h)] / \partial h < 0. \end{aligned}$$

In equation (11), the expression on the left-hand side is the marginal productivity of the health checkup (Ehrlich and Becker 1972, 634).[17] The equi-

15. Approximately 49 percent of patients in large hospitals wait for at least an hour and a half, and 15 percent wait for more than three hours. By comparison, these rates are 44 percent and 17.2 percent for medium-sized hospitals, and 28 percent and 15.6 percent for small hospitals (Health and Welfare Statistics Association 1999, 84). However, medical examinations in hospitals are very quick; almost 64 percent of patients in large hospitals take only ten minutes or less for their examinations, and 18 percent take less than three minutes. About 61 percent and 57 percent of patients in medium-sized and small hospitals, respectively, take ten minutes or less for their medical examinations.

16. Here we drop the state subscripts so that $\pi = \pi_2$ and $1 - \pi = \pi_1$.

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

librium condition requires $1 + \pi_h^* L(A, H) < 0$. That is, an additional dollar spent on health checkups must reduce the expected loss by more than a dollar.[18] In other words, if an individual does not expect the benefits from the reduction of his expected loss to be greater than the cost of the health checkup, he will not have the health checkup. Using equation (10) to restate this point, if the maximum EU occurs when $h = 0$, rather than when $h > 0$, then necessarily $\text{EU}' \leq 0$; hence, we will have a corner solution. Furthermore, even if $h > 0$ to start with, there may be some range of EU over which $\text{EU}' \leq 0$. This may be the case when $-1 \leq \pi_h^* L(A, H) \leq 0$. Then the individual will not have a health checkup, because $\text{EU}(h = 0) > \text{EU}(h > 0)$. For example, when the individual already has adequate, positive information on his current health condition, it does not make any sense for him to see a medical doctor at the hospital for a slight cough.

The second-order condition of equation (10) requires

$$D = [1 - \pi(A)]U_{xx} + \pi(A)U_{yy}[1 + \pi_h^* L(A, H)]^2 < 0, \tag{12}$$

where

$U_{xx} = \partial U_x / \partial x < 0,$
$U_{yy} = \partial U_y / \partial x < 0,$
$\partial \pi_h^* / \partial h = [\partial^2 \pi^*(h)] / \partial h^2 = 0$ (assumed without loss).

The effect of age on the demand for a health checkup h can be found by partially differentiating the first-order optimality condition, equation (10), with respect to A, as follows:

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

where

$\pi_A = [\partial \pi(A)] / \partial A > 0,$
$L_A = [\partial L(A, H)] / \partial A > 0.$

The above suggests that as people grow older, they become more health conscious and hence go for their health checkups.

Let us now consider the case of an increase in the health insurance premium (or tax) P. That is, the relative coverage of medical care decreases in clinics and hospitals. The effect of an increase in P on health checkups is negative, as shown in the following equation:

$$\frac{\partial h}{\partial P} = \frac{-1}{D}\{[1 - \pi(A)]U_{xx} + \pi(A)U_{yy}[1 + \pi_h^* L(A, H)]\} < 0, \tag{14}$$

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

since $[(1 - \pi(A))U_{xx} + \pi(A)U_{yy}(1 + \pi_h^* L(A, H))] < 0$ (see the appendix). In other words, as medical care coverage increases, an individual is more likely to have a health checkup.

The effect of an increase in an individual's initial endowment S_0 is positive, as shown in the following equation:

$$(15) \qquad \frac{\partial h}{\partial S_0} = \frac{1}{D}\{[1 - \pi(A)]U_{xx} + \pi(A)U_{yy}[1 + \pi_h^* L(A, H)]\} > 0.$$

This result in equation (15) shows that individuals with higher earning potential—for instance, those with larger stocks of human capital—are willing to have health checkups to secure against future earnings losses.

We now consider whether an individual who is willing to participate in health-stock-augmenting activities will have a health checkup. By partially differentiating the first-order optimality condition, we have

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

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

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

We can also evaluate the effect of the psychological burden g, which is a burden incurred by an individual due to his illness. When an individual is sick and has to wait for many hours at a busy hospital, there are psychological costs, such as fatigue. In cases of severe illness, he may have to be hospitalized and medical treatment may take several hours or days. The effect of an increase in g on h is positive:

$$(17) \qquad \frac{\partial h}{\partial g} = \frac{1}{D}\{\pi(A)U_{yy}[1 + \pi_h^* L(A, H)](-M)\} > 0.$$

When an individual believes he is prone to some serious illness, perhaps through his job, he is more willing to have a health checkup in order to lessen the psychological burden should he fall ill.

On the other hand, the effect of an increase in medical benefits M is negative:

$$(18) \qquad \frac{\partial h}{\partial M} = \frac{1}{D}\{\pi(A)U_{yy}[1 + \pi_h^* L(A, H)](1 - g)\} < 0.$$

Hence, the individual becomes less self-protective as benefits increase, the classical moral hazard result.

Finally, we consider the effect of gender on health checkups. In equation

(7), the expected loss $\pi^*(h)L(A, H)$ can be computed separately by gender. Suppose

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

where $\overline{L^i}$ is a gender-specific expected loss ($i = f, m$: f = females, and m = males). $\overline{L^i}$ is a positive function of both $\pi^i(h)$ and $L^i(A, H)$, and we assume $\pi^f(h) < \pi^m(h)$ and $L^f(A, H) < L^m(A, H)$.

The effect of an increase (or shift) in the probability distribution over health checkups is found to be

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

which follows from the assumption, $(\partial\pi_h^*)/[\partial\pi^i(h)] = 0$.

The above result indicates that individuals who are more prone to illness are more likely to have health checkups. The positive relationship can also be applied to $\overline{L^i}$; that is, $\partial h/\partial\overline{L^i} > 0$. Therefore, under the assumptions listed above, males are more likely to have health checkups than females.

These comparative static predictions must now be evaluated in an empirical setting. For the empirical specification, we assume that an individual's decision to have a health checkup depends on an unobservable utility index I_i, defined as

$$(21) \qquad I_i = \mathbf{X_i}\boldsymbol{\beta} + u_i,$$

where $\mathbf{X_i}$ is a $(1 \times k)$ row vector of explanatory variables that determine I_i, $\boldsymbol{\beta}$ is a $(k \times 1)$ column vector of parameters to be estimated, and u_i is a normally distributed random error term. The larger the value of the index I_i, the greater the probability an individual will have a health checkup.

We further assume that there is a critical level of the index I_i^*, such that if I_i exceeds I_i^*, the individual will have a health checkup, and otherwise he will not. In terms of the notation used above, $[1 + \pi_h^* L(A, H)] < 0$ and $\partial \mathrm{EU}/\partial h = 0$ at $h > 0$ imply $I_i - I_i^* \geq 0$. Let $h = 1$ if the individual has a health checkup, and $h = 0$ if he does not. Since I_i, I_i^*, and $[1 + \pi_h^* L(A, H)]$ are not observable, we assume I_i and I_i^* to be normally distributed with the same mean and variance. Then, the probability that the individual has a health checkup can be expressed as

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

where $F(\cdot)$ is the cumulative distribution function, and t is a standardized normal variable—that is, $t \sim N(0, 1)$.[19] We estimate a probit model of the demand for health checkups and a tobit model for the length of hospital stay. The next section presents the explanatory variables used in these analyses.

19. The presentation of this probit model is from Gujarati (1995, 563–64).

Table 10.6 Distribution of Retirement Ages by Firm Size and Industry, 1997

	Retirement Age (%)				
	Under 55	56–59	60	61–64	65
Firm size					
30–99	5.7	6.6	78.4	0.9	8.3
100–299	2.7	2.5	88.1	2.9	3.8
300–999	1.9	2.3	91.9	2.0	1.9
1,000–4,999	0.1	0.4	96.8	1.7	1.0
5,000 and over	0.0	0.0	98.0	0.7	1.3
Industry					
Mining	5.8	8.3	76.7	3.3	5.8
Construction	3.6	1.7	69.6	0.9	23.9
Manufacturing	4.2	4.2	86.8	1.1	3.5
Electricity	3.1	4.7	89.8	1.6	0.8
Transportation and communication	3.6	9.4	76.3	5.2	5.6
Wholesale and retail	7.3	6.4	84.5	0.3	1.5
Finance and insurance	2.3	1.7	93.8	1.2	1.1
Real estate	1.7	2.8	89.2	0.8	5.5
Services	3.9	6.2	77.9	1.9	10.0

Source: Statistics Bureau (1998, 94).

Notes: Electricity includes gas, heat, and water as well as electricity. Wholesale and retail industry includes eating and drinking establishments.

10.4.2 Variables

Using the model outlined above, we examine the effects of several variables on the demand for health checkups. The dependent variable is a dummy variable that equals 1 if the individual has a health checkup and 0 otherwise.

A critical factor in explaining the variation in demand for medical health checkups is age. Theoretically, the relationship between age and medical health checkups should be positive and slowly increasing until the age of sixty, and declining thereafter. The reason for this decline is that the retirement age is sixty for those working in relatively large firms (see table 10.6).[20] Note, however, that new retirees are still eligible for a type of health insurance managed by associations or health insurance managed by the government for two years following retirement. Otherwise, these individuals purchase NHI.

Gender is another major explanatory variable used in this analysis. The male health checkup rate always exceeds the female rate in the twenty-to-sixty-four age range. This differential in health checkup rates certainly results from biological differences as well as socioeconomic and demo-

20. Employees covered by employees' health insurance obtain NHI after retirement.

graphic variables. We examine the effect of gender on the demand for health checkups, ceteris paribus.

In addition to the above demographic variables, another important explanatory variable is health insurance coverage. This includes health insurance managed by associations, health insurance managed by the government, and NHI. The former two types of insurance cover 80 percent of medical costs (70 percent for dependents), whereas the NHI covers 70 percent for everyone.

To examine the effect of an individual's initial endowment on health checkups, we use a dummy variable to indicate the household's highest income earner (the breadwinner) and include the household's monthly expenditure, which should have an income effect on the demand for health checkups. To account for nonreporting bias, we include a dummy variable for those records with missing income values.

To measure an individual's health-stock-augmenting activities, we use the frequency of daily practices such as eating regular meals, nutritiously balanced meals, and not-too-salty meals; eating in moderation; exercising; getting adequate sleep; and taking time to refresh oneself during the day. We hypothesize that the effect of this variable on the demand for health checkups is positive.

To evaluate the effect of the psychological burden associated with illness, the number of illnesses the individual reports is included as an explanatory variable. This number includes diseases of the circulatory system, respiratory system, digestive system, genitourinary system, and so forth. Although the illnesses of each system could be explanatory variables in the regression, we elect not to use this approach because of the difficulty in evaluating differences in the effects. Also, there are too many to be meaningful for our purposes. In addition to the illness variable, we include the number of stressful events the individual has had to face. These two explanatory variables are considered to be objective measures of health. To avoid specification error, the subjective evaluation of an individual's health condition should also be included in the regression analysis. To do this, we use three dummy variables indicating whether the individual feels he or she is in excellent, good, or fair health.

To capture the effect of medical benefits on the demand for health checkups, we use a life insurance variable as a proxy for benefits. There are various types of life insurance. Some provide coverage only for hospitalization costs and injuries.

To examine the effect of a change in the likelihood of illness on health checkups, we use a dummy variable for whether the individual has visited a clinic or hospital in the past year. If the individual did not visit either for an entire year, the individual is considered to be healthy, ceteris paribus. The probability that he or she falls ill is lower than that of someone who has visited these institutions in recent months.

In addition to the explanatory variables described above, variables measuring education, firm size, type of employment, population size, and regional dummies are also included in the regression models. The definitions and summary statistics of all of the variables are reported in table 10.7.[21] In the next section, we report the empirical results of the probit analysis.

10.5 Empirical Results

10.5.1 Health Checkup Results for the 20–64 and 30–60 Age Groups

Table 10.8 reports the results of probit and ordinary least squares (OLS; linear probability model) analyses for the twenty-to-sixty-four and thirty-to-sixty age groups. Table 10.9 reports the results of the thirty-to-sixty age group by gender. The overall results are quite similar in terms of the significance of the estimated coefficients, which are very robust. The OLS estimates are shown for comparative purposes. We will mainly discuss the results of the probit model in terms of the signs of the estimated coefficients.

First, MALE is significant and positive in both age groups, as expected (see table 10.8). After controlling for other socioeconomic and demographic variables (discussed in section 10.4), we do not reject the argument that males are more likely than females to have health checkups because their genetic and biological characteristics make them more prone to illness. The estimated coefficients on AGE and AGESQ (age^2) are both highly significant. The positive estimated coefficient on AGE and the negative estimated coefficient on AGESQ for both age groups indicate that the profile of health checkups is concave in age. The probit estimate on AGE for the thirty-to-sixty age group is 0.083 and is about twice as large as that for the twenty-to-sixty-four age group, which is 0.037. This shows that the former is more concerned with their health than the latter. The changes in the health checkup rate as age increases, or the estimated coefficient on AGESQ, indicate that individuals lose health stock as they age.

As mentioned earlier, health checkups are time-consuming health inputs. Hence, the opportunity cost of lost work hours or days for the sake of a health checkup should be a major determinant of an individual's decision to have a health checkup. The sign of the wage rate (WAGE) is negative and highly significant. Again, the probit coefficient for the thirty-to-sixty age group (–0.259) is two times larger in absolute value than that for the twenty-to-sixty-four population (–0.139). The corresponding *t*-statistics also indicate stronger significance of the former than of the latter.[22] The es-

21. This study focuses on those aged thirty to sixty. However, statistics for the twenty-to-sixty-four age group are also reported. Gender-specific statistics are available from the authors upon request.

22. The results are the same for the OLS estimates.

Table 10.7 Description and Statistics (Year = 1995)

Variable	Description	Age 20–64 (N = 438,906) Mean	Age 20–64 (N = 438,906) Standard Deviation	Age 30–60 (N = 310,134) Mean	Age 30–60 (N = 310,134) Standard Deviation
HCHECKUP	If the individual has health checkup, HCHECKUP = 1; otherwise = 0.	0.557	0.497	0.584	0.493
MALE	If the individual is male, MALE = 1; otherwise = 0.	0.490	0.500	0.491	0.500
AGE	Age	42.314	12.737	45.250	8.576
AGESQ	Age squared.	1,952.690	1,076.338	2,121.134	777.190
MARRIED	If the individual is married, MARRIED = 1; otherwise = 0.	0.722	0.448	0.846	0.361
WAGE	Wage rate per hour (in 1,000 yen)[a]	1.490	0.454	1.613	0.467
BREADWIN	If the individual is the highest income earner in the household, BREADWIN = 1; otherwise = 0.	0.438	0.496	0.488	0.500
MONTHEXP	Monthly expenditures (in 10,000 yen)	28.910	38.096	29.581	38.240
MOEXPDUM	If monthly expenditures are not reported, MOEXPDUM = 1; otherwise = 0.	0.062	0.240	0.060	0.237
ASOCHI	If the individual has health insurance managed by associations, ASOCHI = 1; otherwise = 0.	0.237	0.425	0.237	0.425
GOVTHI	If the individual has health insurance managed by government, GOVTHI = 1; otherwise = 0.	0.324	0.468	0.326	0.469
MUTUHI	If the individual has mutual aid associations insurance, MUTUHI = 1; otherwise = 0.	0.111	0.315	0.124	0.329
NHI	If the individual has national health insurance, NHI = 1; otherwise = 0.	0.315	0.465	0.300	0.458
SIZE1000	If the individual is an employee of a firm with 1,000 employees or more, SIZE1000 = 1; otherwise = 0.	0.081	0.272	0.080	0.271
SIZE500	If the individual is an employee of a firm with 500–999 employees, SIZE500 = 1; otherwise = 0.	0.029	0.168	0.028	0.164
SIZE100	If the individual is an employee of a firm with 100–499 employees, SIZE100 = 1; otherwise = 0.	0.093	0.290	0.091	0.288

(*continued*)

Table 10.7 (continued)

		Age 20–64 (N = 438,906)		Age 30–60 (N = 310,134)	
Variable	Description	Mean	Standard Deviation	Mean	Standard Deviation
SIZE30	If the individual is an employee of a firm with 30–99 employees, SIZE30 = 1; otherwise = 0.	0.100	0.301	0.100	0.300
SIZE5	If the individual is an employee of a firm with 5–29 employees, SIZE5 = 1; otherwise = 0.	0.114	0.318	0.113	0.317
SIZE1	If the individual is an employee of a firm with 1–4 employees, SIZE1 = 1; otherwise = 0.	0.024	0.154	0.025	0.155
PUBEMPLY	If the individual is a public employee, PUBEMPLY = 1; otherwise = 0.	0.059	0.235	0.067	0.250
DOCTOR	The number of physicians per 100,000 population in a prefecture.	187.035	35.828	186.946	35.618
PROFES	If the individual is a professional such as engineer, PROFES = 1; otherwise = 0.	0.111	0.314	0.115	0.319
ADMINI	If the individual is an administrator, ADMINI = 1; otherwise = 0.	0.047	0.212	0.058	0.233
CLERIC	If the individual is a clerk, CLERIC = 1; otherwise = 0.	0.124	0.329	0.115	0.320
SALES	If the individual is a salesperson, SALES = 1; otherwise = 0.	0.081	0.273	0.085	0.279
SERVIC	If the individual is an employee of the service industry, SERVIC = 1; otherwise = 0.	0.073	0.260	0.076	0.265
SECURI	If the individual has a security-related job, SECURI = 1; otherwise = 0.	0.008	0.089	0.009	0.092
TRANSP	If the individual is an employee of the transportation industry, SERVIC = 1; otherwise = 0.	0.024	0.153	0.027	0.163
SICKNUMB	The number of injuries and illnesses.	0.366	0.792	0.372	0.791
STRESS	The number of stressful events that had been or are being experienced.	0.944	1.556	1.014	1.624
NOTVISIT	If the individual did not visit medical institutions for the past year, NOTVISIT = 1; otherwise = 0.	0.084	0.278	0.089	0.285
HLTHPRAC	The number of health-related daily practices.	2.507	1.901	2.545	1.878

HLTHEXCE	Self-evaluation of the individual's health: if excellent, HLTHEXCE = 1; otherwise = 0.	0.316	0.465	0.300	0.458
HLTHGOOD	Self-evaluation of the individual's health: if good, HLTHGOOD = 1; otherwise = 1.	0.175	0.380	0.175	0.380
HLTHFAIR	Self-evaluation of the individual's health: if fair, HLTHFAIR = 1; otherwise = 0.	0.385	0.487	0.399	0.490
EDU	The average proportion of high school graduates who went to either college or university in a prefecture.	0.369	0.100	0.368	0.100
LIFEINSU	The average amount of life insurance's contract (in 10,000 yen) in a prefecture.	780.724	64.988	779.765	64.886
POP1M	If the individual lives in a city with a population of about 1 million or more, POP1M = 1; otherwise = 0.	0.139	0.345	0.134	0.340
POP150	If the individual lives in a city with a population of more than 150,000 but less than 1 million, POP150 = 1; otherwise = 0.	0.268	0.443	0.264	0.441
POP50	If the individual lives in a city with a population of more than 50,000 but less than 150,000, POP50 = 1; otherwise = 0.	0.094	0.292	0.096	0.295
POPCUNTY	If the individual lives in a city or town with a population of less than 50,000, POPCUNTY = 1; otherwise = 0.	0.289	0.453	0.295	0.456
REGIOND1	Regional dummy: Hokkaido = 1; otherwise = 0.	0.021	0.144	0.022	0.145
REGIOND2	Regional dummy: Tohoku = 1; otherwise = 0.	0.139	0.346	0.142	0.349
REGIOND4	Regional dummy: KantoII = 1; otherwise = 0.	0.111	0.314	0.111	0.314
REGIOND5	Regional dummy: Hokuriku = 1; otherwise = 0.	0.087	0.282	0.088	0.283
REGIOND6	Regional dummy: Tokai = 1; otherwise = 0.	0.072	0.259	0.072	0.258
REGIOND7	Regional dummy: Kinki I = 1; otherwise = 0.	0.046	0.209	0.044	0.206
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	0.305	0.104	0.306
REGIOND10	Regional dummy: Sikoku = 1; otherwise = 0.	0.076	0.265	0.077	0.267
REGIOND11	Regional dummy: Kita Kyusyu = 1; otherwise = 0.	0.090	0.286	0.090	0.286
REGIOND12	Regional dummy: Minami Kyusyu = 1; otherwise = 0.	0.075	0.263	0.076	0.265

[a]The wage rate is the gender-specific industry average wage rate for different age groups, namely, 20–24, 25–29, . . . , 55–59, and 60–64.

Table 10.8 Probit and OLS Estimates of Health Checkup Probabilities

	Age 20–64				Age 30–60			
	Probit		OLS		Probit		OLS	
Variable	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
C	–1.503	–29.110	–0.015	–0.846	–2.553	–28.704	–0.363	–12.216
MALE	0.041	4.260	0.016	4.981	0.163	12.015	0.060	13.161
AGE	0.037	22.557	0.013	23.561	0.083	23.775	0.029	24.467
AGESQ	–0.000	–11.723	–0.000	–12.283	–0.001	–18.185	–0.000	–18.730
MARRIED	0.004	0.789	–0.000	–0.010	0.075	10.645	0.024	10.090
WAGE	–0.139	–13.886	–0.056	–16.561	–0.259	–18.928	–0.097	–21.410
BREADWIN	0.095	16.362	0.032	16.105	0.061	8.029	0.020	7.793
MONTHEXP	0.000	6.193	0.000	6.081	0.000	4.328	0.000	4.369
MOEXPDUM	–0.080	–9.279	–0.028	–9.457	–0.088	–8.493	–0.030	–8.734
ASOCHI	0.305	16.495	0.106	16.793	0.320	14.609	0.111	15.008
GOVTHI	0.216	11.855	0.077	12.319	0.210	9.750	0.076	10.401
MUTUHI	0.295	15.062	0.102	15.214	0.283	12.291	0.099	12.686
NHI	–0.037	–2.008	–0.014	–2.181	–0.063	–2.938	–0.025	–3.365
SIZE1000	0.962	98.944	0.323	104.239	0.962	80.305	0.310	84.435
SIZE500	0.811	60.243	0.283	64.671	0.800	47.470	0.271	51.581
SIZE100	0.743	89.130	0.261	94.499	0.731	72.410	0.252	77.221
SIZE30	0.537	68.696	0.194	72.710	0.527	56.391	0.189	60.470
SIZE5	0.227	31.468	0.082	32.877	0.226	26.459	0.084	28.403
SIZE1	–0.085	–6.413	–0.033	–7.215	–0.075	–4.860	–0.030	–5.643
PUBEMPLY	0.821	63.152	0.275	65.890	0.842	55.552	0.271	57.303
DOCTOR	0.000	2.658	0.000	3.376	0.000	2.882	0.000	3.856
PROFES	0.111	15.188	0.040	16.321	0.118	13.636	0.042	14.807
ADMINI	0.226	21.206	0.072	20.898	0.232	19.730	0.073	19.561
CLERIC	0.147	20.486	0.052	21.521	0.170	19.237	0.057	19.971
SALES	–0.031	–3.994	–0.010	–3.705	–0.020	–2.181	–0.006	–1.886
SERVIC	–0.048	–5.855	–0.016	–5.893	–0.025	–2.577	–0.008	–2.434

SECURI	0.132	5.259	0.048	6.096	0.124	4.198	0.047	5.218
TRANSP	0.027	1.948	0.011	2.272	0.037	2.327	0.014	2.752
SICKNUMB	0.138	48.575	0.046	48.973	0.140	41.478	0.046	41.860
STRESS	0.047	33.917	0.016	33.587	0.048	30.312	0.016	30.141
NOTVISIT	–0.162	–22.335	–0.057	–22.824	–0.184	–21.745	–0.063	–22.205
HLTHPRAC	0.081	71.211	0.027	71.785	0.080	58.508	0.027	58.724
HLTHEXCE	0.419	56.030	0.142	56.617	0.415	46.744	0.141	47.531
HLTHGOOD	0.481	60.929	0.163	61.568	0.481	51.441	0.162	52.226
HLTHFAIR	0.460	66.895	0.157	67.808	0.457	56.492	0.154	57.349
EDU	–0.651	–14.155	–0.232	–14.925	–0.779	–14.109	–0.279	–15.197
LIFEINSU	–0.000	–8.786	–0.000	–8.793	–0.000	–3.940	–0.000	–3.684
POP1M	–0.046	–5.819	–0.016	–5.862	–0.044	–4.540	–0.015	–4.535
POP150	–0.063	–10.574	–0.022	–10.859	–0.069	–9.643	–0.023	–9.848
POP50	0.097	12.075	0.034	12.427	0.115	12.118	0.039	12.359
POPCUNTY	0.224	37.968	0.077	38.813	0.238	33.798	0.080	34.507
REGIOND1	–0.257	–15.375	–0.092	–16.288	–0.312	–15.290	–0.112	–16.375
REGIOND2	0.046	4.034	0.012	3.148	–0.006	–0.408	–0.007	–1.572
REGIOND4	–0.011	–1.130	–0.006	–1.709	–0.037	–3.129	–0.015	–3.838
REGIOND5	0.053	4.937	0.016	4.502	0.022	1.649	0.005	1.053
REGIOND6	0.004	0.325	0.001	0.213	–0.005	–0.418	–0.002	–0.537
REGIOND7	–0.124	–10.085	–0.044	–10.546	–0.145	–9.666	–0.051	–10.186
REGIOND8	–0.186	–16.230	–0.064	–16.668	–0.207	–14.962	–0.071	–15.473
REGIOND9	–0.070	–6.059	–0.027	–6.837	–0.117	–8.111	–0.043	–9.030
REGIOND10	–0.234	–18.525	–0.084	–19.590	–0.288	–18.285	–0.103	–19.515
REGIOND11	–0.159	–13.356	–0.058	–14.436	–0.205	–13.590	–0.075	–14.865
REGIOND12	–0.123	–9.942	–0.047	–11.253	–0.199	–12.548	–0.075	–14.150
R^2	0.1767		0.1730		0.1806		0.1763	
Log-likelihood	–260,004		–273,960		–180,789		–190,634	
F-statistic	—		1,799.85		—		1,301.02	
N	438,906		438,906		310,134		310,134	

[a]Coefficients are significant at the 1 percent level, 5 percent level, and 10 percent level if the asymptotic *t*-statistics are greater than 2.576, 1.960, and 1.645, respectively.

Table 10.9 **Profit and OLS Estimates of Health Checkup Probabilities by Gender**

	Males Aged 30–60				Females Aged 30–60			
	Probit		OLS		Probit		OLS	
Variable	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
C	–1.580	–10.298	0.013	0.265	–2.998	–24.237	–0.525	–12.220
AGE	0.044	6.381	0.013	6.172	0.090	20.381	0.030	19.801
AGESQ	–0.000	–5.102	–0.000	–4.885	–0.001	–14.258	–0.000	–13.507
MARRIED	0.161	15.851	0.054	16.679	0.005	0.407	0.000	0.021
WAGE	–0.129	–5.130	–0.045	–5.816	–0.018	–0.737	–0.008	–0.961
BREADWIN	0.070	6.388	0.024	6.958	0.002	0.153	–0.002	–0.425
MONTHEXP	0.000	2.383	0.000	2.294	0.000	3.617	0.000	3.748
MOEXPDUM	–0.103	–6.887	–0.034	–7.236	–0.079	–5.470	–0.028	–5.449
ASOCHI	0.377	12.494	0.129	13.152	0.318	9.906	0.113	10.078
GOVTHI	0.224	7.627	0.083	8.668	0.211	6.640	0.076	6.825
MUTUHI	0.392	11.673	0.132	12.408	0.286	8.631	0.102	8.792
NHI	–0.203	–6.910	–0.079	–8.231	0.013	0.401	0.004	0.403
SIZE1000	0.781	49.536	0.240	50.789	0.987	42.214	0.331	44.747
SIZE500	0.650	30.909	0.211	33.539	0.795	25.589	0.275	27.166
SIZE100	0.611	43.205	0.202	45.746	0.703	45.019	0.247	47.200
SIZE30	0.425	31.656	0.147	33.992	0.510	36.807	0.185	38.638
SIZE5	0.134	10.890	0.046	11.239	0.232	18.350	0.087	19.355
SIZE1	–0.155	–7.067	–0.062	–8.599	–0.037	–1.694	–0.014	–1.782
PUBEMPLY	0.626	26.261	0.196	27.860	0.876	37.464	0.284	38.053
DOCTOR	0.000	0.909	0.000	1.136	–0.000	–0.130	–0.000	–0.028
PROFES	0.016	1.437	0.006	1.753	0.219	15.211	0.076	15.549

ADMINI	0.178	12.870	0.052	12.471	0.086	3.277	0.032	3.479
CLERIC	0.107	8.020	0.031	7.797	0.198	16.254	0.070	16.768
SALES	–0.094	–7.443	–0.033	–8.087	0.008	0.614	0.003	0.769
SERVIC	–0.090	–6.087	–0.031	–6.573	–0.006	–0.439	–0.001	–0.231
SECURI	0.060	1.843	0.024	2.524	0.239	2.879	0.085	2.997
TRANSP	–0.006	–0.351	–0.001	–0.267	0.048	0.770	0.019	0.904
SICKNUMB	0.143	27.225	0.044	27.782	0.133	30.195	0.045	30.249
STRESS	0.058	23.219	0.018	23.564	0.043	21.295	0.015	21.018
NOTVISIT	–0.167	–13.002	–0.054	–13.112	–0.194	–17.241	–0.069	–17.602
HLTHPRAC	0.078	39.020	0.024	39.365	0.083	43.831	0.029	44.264
HLTHEXCE	0.502	39.078	0.168	41.152	0.343	27.765	0.117	27.515
HLTHGOOD	0.579	42.275	0.191	44.302	0.402	31.224	0.138	31.094
HLTHFAIR	0.547	45.932	0.181	47.946	0.382	34.601	0.132	34.558
EDU	–0.629	–6.479	–0.188	–6.220	–0.826	–8.932	–0.290	–9.009
LIFEINSU	–0.000	–3.437	–0.000	–3.396	–0.000	–4.242	–0.000	–4.125
POP1M	–0.036	–2.507	–0.011	–2.600	–0.078	–5.778	–0.028	–5.987
POP150	–0.032	–3.074	–0.010	–3.158	–0.101	–10.391	–0.036	–10.543
POP50	0.066	4.706	0.022	4.922	0.157	12.025	0.055	12.112
POPCUNTY	0.163	15.829	0.053	16.401	0.301	31.205	0.106	31.462
R^2	0.1947		0.1901		0.1553		0.1522	
Log-likelihood	–83,533		–87,652		–96,228		–101,383	
F-statistic	—		714,883		—		566.706	
N	152,255		152,255		157,879		157,879	

Note: All regressions include the eleven regional dummies.

[a]Coefficients are significant at the 1 percent level, 5 percent level, and 10 percent level if the asymptotic *t*-statistics are greater than 2.576, 1.960, and 1.645, respectively.

timated coefficient on the variable BREADWIN is significantly positive, and the robust effect shows, as previously hypothesized, that the highest earner of a household is more willing to have health checkups to secure against the loss of earnings that would result from becoming ill. From the estimated coefficient on monthly household expenditures (MONTHEXP), we see that the income elasticity of the demand for health checkups is positive.

The individual's type of health insurance coverage is included as the policy variable in the model: ASOCHI, GOVTHI, MUTUHI, and NHI. As expected, the coefficients on the first three variables are positive, while that on NHI is negative. All estimates are statistically significant. Hence, the greater the coverage of medical care, the more likely the individual is to have a health checkup. If health checkups do constitute preventive medical care, individuals having health checkups will be less prone to illness.[23] As of 1995, life expectancy in Japan was 77.01 years for males and 83.59 years for females (Statistics Bureau 1998). The longevity of the Japanese may be attributed to the current health checkup program under the comprehensive health (medical) insurance system.

Normally, firms with a larger number of employees face more restrictions regarding employees' working conditions. Therefore, these firms usually provide more and better fringe benefits compared to firms with fewer employees. In our study, we use SIZE1000 for institutions with 1,000 employees or more, SIZE500 for those with 500–999 employees, SIZE100 for those with 100–499 employees, SIZE30 for those with 30–99 employees, SIZE5 for those with 5–29 employees, SIZE1 for those with 1–5 employees, and PUBEMPLY for public employees.[24] The estimated coefficients on the variables SIZE5 to SIZE1000 are highly significant and positive, as is that of PUBEMPLY. On the other hand, small institutions that fall within SIZE1 have a negative estimated coefficient. These results are indicative of the better working environments provided by larger firms.

We now turn to the effects of the individual's health condition on the demand for health checkups, holding constant the subjective evaluation of own health (HLTHEXCE, HLTHGOOD, and HLTHFAIR). First, the sign of the estimated coefficient on NOTVISIT is negative, while that on HLTHPRAC is positive. The former is a dummy variable that equals 1 if the individual did not visit any medical institutions during the past year. The latter is the number of health-related daily practices in which the individual engages (e.g., eating regular meals; eating low-salt, nutritionally balanced meals; getting adequate physical exercise and adequate hours of sleep; and so on). The signs of these variables conform to expectations. In

23. This issue will be discussed further when we present the empirical results on the probability of hospitalization.

24. The omitted dummy variable for firm size indicates the self-employed, family workers, part-time workers, and the unemployed.

other words, an individual with better health (or more health stock) is less likely to have a health checkup. On the other hand, a health-conscious person, that is, an individual who practices health-stock-augmenting activities, tends to have health checkups. For these health-conscious people, having a health checkup is another way of preventing health deterioration.

To evaluate the effect of the psychological burden of being ill, the variables SICKNUMB (the number of injuries and illnesses) and STRESS (the number of stressful events encountered) are included as explanatory variables. We hypothesized in the previous discussion that the psychological burdens of being ill and being in a queue at a hospital will provide incentives for the individual not to become ill. It is thus possible that the individual will go for health checkups to avoid becoming a patient. Both estimated coefficients on SICKNUMB and STRESS are positive and highly significant. The sizes of the coefficients for the twenty-to-sixty-four age group are almost identical to those of the thirty-to-sixty age group, ceteris paribus.

Finally, we examine the estimated coefficients on education (EDU) and life insurance (LIFEINSU). Education is usually considered to be a factor that increases the efficiency of health production. The variable normally has a positive effect on the demand for preventive medical care (Coffey 1983; Kenkel 1994; and Hsieh and Lin 1997, to name only a few). However, according to Grossman (1972), the coefficient on 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 1 in absolute value. In this respect, the estimated negative coefficient is not necessarily wrong.[25] The estimated effect of LIFEINSU on the demand for health checkups is negative. That is, an individual with life insurance is less likely to have a health checkup. This result is similar to the canonical story of an individual who buys insurance, but also gambles (see Silberberg 1990, 453). One may also take the view that the significantly negative coefficient reflects the moral hazard inherent in the health checkup decision.

10.5.2 Other Health Checkup Results

This section highlights some results from breakdowns of the sample. Table 10.9 reports gender-specific results for the population aged thirty to sixty, and table 10.10 reports age group–specific results for ages thirty to thirty-nine, forty to forty-nine, and fifty to sixty.

First, concerning the gender-specific results in table 10.9, the age effect (AGE) is much stronger for females (0.090) than for males (0.044). After controlling for all other socioeconomic and demographic factors, females

25. However, the definitive sign analysis must await further study using microdata on education, since our survey data do not provide this variable. Therefore, we use a proxy variable (see EDU in table 10.7).

Table 10.10 **Probit Estimates of Health Checkup Probabilities by Age**

	Age 30–39 Probit		Age 40–49 Probit		Age 50–60 Probit	
Variable	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
C	–1.568	–2.121	–1.364	–1.180	2.690	1.854
MALE	0.187	7.233	–0.016	–0.592	–0.157	–5.983
AGE	0.040	0.940	0.025	0.471	–0.132	–2.484
AGESQ	–0.000	–0.182	–0.000	–0.230	0.001	2.710
MARRIED	0.015	1.335	0.144	11.513	0.161	11.423
WAGE	–0.192	–4.724	–0.041	–1.436	0.017	0.728
BREADWIN	0.105	8.213	0.077	5.809	0.108	7.200
MONTHEXP	0.000	1.248	0.000	2.791	0.000	3.179
MOEXPDUM	–0.063	–3.088	–0.075	–4.397	–0.114	–6.643
ASOCHI	0.155	3.697	0.374	10.478	0.387	10.395
GOVTHI	0.037	0.886	0.262	7.469	0.281	7.732
MUTUHI	0.101	2.325	0.370	9.870	0.353	8.811
NHI	–0.220	–5.257	–0.062	–1.766	0.011	0.302
SIZE1000	1.042	49.837	0.921	47.915	0.834	35.867
SIZE500	0.857	30.132	0.800	29.196	0.671	20.424
SIZE100	0.863	47.605	0.690	42.490	0.589	31.465
SIZE30	0.632	36.406	0.501	33.330	0.432	25.812
SIZE5	0.332	20.545	0.211	15.371	0.135	8.954
SIZE1	–0.052	–1.788	–0.051	–2.137	–0.111	–3.921
PUBEMPLY	0.945	36.809	0.810	32.710	0.690	23.312
DOCTOR	0.000	2.172	0.000	0.238	0.000	–2.697
PROFES	0.157	10.364	0.109	7.850	0.053	3.176
ADMINI	0.259	9.698	0.233	12.349	0.212	11.552
CLERIC	0.215	14.240	0.151	10.708	0.106	5.974
SALES	0.010	0.603	–0.020	–1.420	–0.071	–4.587
SERVIC	–0.038	–1.980	–0.031	–2.009	–0.024	–1.462
SECURI	0.077	1.553	0.173	3.589	0.072	1.227
TRANSP	0.006	0.206	–0.010	–0.396	0.136	4.845
SICKNUMB	0.116	13.779	0.136	22.543	0.145	30.871
STRESS	0.035	12.853	0.049	19.166	0.065	21.517
NOTVISIT	–0.115	–7.001	–0.191	–14.560	–0.227	–15.178
HLTHPRAC	0.059	22.444	0.070	30.617	0.103	45.437
HLTHEXCE	0.307	17.221	0.425	28.466	0.460	31.930
HLTHGOOD	0.355	19.156	0.497	31.449	0.537	35.152
HLTHFAIR	0.345	20.310	0.451	32.998	0.510	40.665
EDU	–0.786	–7.632	–0.747	–8.132	–0.482	–5.057
LIFEINSU	–0.000	–3.053	–0.000	–3.502	–0.000	–3.860
POP1M	–0.049	–2.684	–0.062	–3.829	–0.078	–4.730
POP150	–0.074	–5.550	–0.073	–6.224	–0.065	–5.362
POP50	0.132	7.400	0.110	7.004	0.108	6.669
POPCUNTY	0.229	17.353	0.234	20.253	0.248	20.537
R^2	0.2111		0.1774		0.1566	
Log-likelihood	–51,588.9		–66,409.0		–61,864.5	
N	89,041		114,567		106,526	

Note: All regressions include the eleven regional dummies.

[a]Coefficients are significant at the 1 percent level, 5 percent level, and 10 percent level if the asymptotic *t*-statistics are greater than 2.576, 1.960, and 1.645, respectively.

are more likely to have health checkups than males as age increases. We are unable to satisfactorily justify why there exists a large difference in the estimates. However, we offer the following explanation. The health stock of a female is, for genetic and biological reasons, larger than that of a male. Ceteris paribus, females need more preventive health care. Therefore, they are more willing to have health checkups as they age.

Another noticeable difference is that the estimated coefficient on MARRIED is positive for males (0.161) and positive but very small for females (0.005). A married male bears more responsibility for his household than does a single unmarried male, and thus he must have health checkups to avoid health loss. The coefficient is not statistically significant for females.

The estimated coefficient on NHI is negative and statistically significant for males but positive and not significant for females. It is highly desirable from a policy perspective to motivate self-employed males, including farmers, to have health checkups. If the government is interested in promoting health checkups as a way to prevent illness, these men could be targeted with incentives.

With regard to the industry dummies, the estimates on SALES and SERVICES are negative and statistically significant for males. Therefore, for the same reasons mentioned for NHI, the government needs to be concerned about the working conditions that prevent employees in these industries from having health checkups. Males in the SALES and SERVICES industries could also be candidates for targeted incentives to encourage check-ups.

Turning to the age group results in table 10.10, the effect of MARRIED is not important for the youngest age group (thirty to thirty-nine) but is a dominant factor for the older groups. On the other hand, WAGE has a negative and significant coefficient for the youngest group, whereas it is negative and insignificant for the forty-to-forty-nine group and positive and insignificant for the fifty-to-sixty group. Therefore, in targeting the thirty-to-thirty-nine group, the high opportunity cost of hours spent to have health checkups must be considered by policymakers, especially for health checkups that take a full day. As mentioned earlier, the effect of NHI is significantly negative for both the thirty-to-thirty-nine and forty-to-forty-nine age groups and should be targeted in the promotion of health checkups. Similarly, those working in firms with four or fewer employees (SIZE1) should also be targeted by policymakers.

The results by type of individual health insurance, shown in table 10.11, reveal that males with ASOCHI, GOVTHI or MUTUHI—that is, those who have 80 percent coverage of medical costs—are more likely to have health checkups than are males with NHI (i.e., those with 70 percent coverage). Thus, medical cost coverage also plays a significant role in the health checkup decision. One may also take the view that those with health insurance other than NHI are more informed about health checkups and consequently have more opportunities to have them. When an individual

Table 10.11 Probit Estimates of Health Checkup Probabilities by Type of Health Insurance Coverage

	ASOCHI Probit		GOVTHI Probit		MUTUHI Probit		NHI Probit	
Variable	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
C	–3.326	–17.426	–2.582	–17.192	–3.810	–14.546	–1.671	–10.494
MALE	0.293	9.235	0.199	8.798	0.336	7.985	–0.021	–0.890
AGE	0.112	14.879	0.100	16.537	0.147	13.613	0.046	7.057
AGESQ	–0.001	–12.460	–0.001	–13.397	–0.001	–11.691	–0.000	–4.043
MARRIED	0.027	1.600	0.023	1.865	–0.029	–1.062	0.144	12.616
WAGE	–0.266	–9.012	–0.255	–10.714	–0.326	–7.781	–0.179	–7.382
BREADWIN	0.130	7.155	0.051	3.888	0.032	1.243	0.051	4.129
MONTHEXP	0.000	2.816	0.000	1.690	0.000	2.129	0.000	2.450
MOEXPDUM	–0.121	–5.339	–0.151	–8.086	–0.012	–0.333	–0.033	–1.925
SIZE1000	0.817	46.022	0.854	28.187	0.711	16.903	1.177	21.047
SIZE500	0.664	26.879	0.808	27.811	0.404	5.726	0.916	11.809
SIZE100	0.603	31.550	0.729	49.820	0.586	13.624	0.730	19.878
SIZE30	0.388	18.591	0.549	42.170	0.467	10.497	0.396	15.466
SIZE5	0.103	4.600	0.249	20.068	0.193	4.022	0.184	10.950
SIZE1	–0.214	–4.427	–0.091	–3.463	–0.188	–1.880	0.001	0.060
PUBEMPLY	0.692	9.208	0.833	11.668	0.698	25.861	0.618	4.819
DOCTOR	0.000	1.414	0.000	0.577	0.000	–0.646	0.000	1.745
PROFES	0.163	8.644	0.145	9.597	0.226	8.272	0.074	4.548
ADMINI	0.336	13.674	0.215	11.534	0.295	8.687	0.105	3.752
CLERIC	0.228	13.288	0.188	13.454	0.308	10.809	0.017	0.747

SALES	0.151	7.381	–0.026	–1.703	0.139	2.573	–0.096	–6.785
SERVIC	0.070	3.115	–0.031	–1.904	0.195	4.630	–0.075	–4.918
SECURI	0.114	1.419	0.034	0.450	0.241	5.214	0.135	1.340
TRANSP	0.025	0.712	0.001	0.060	0.256	5.260	–0.030	–0.773
SICKNUMB	0.138	17.852	0.135	22.469	0.115	10.093	0.151	27.774
STRESS	0.063	18.830	0.046	16.525	0.054	11.411	0.039	13.991
NOTVISIT	–0.205	–11.197	–0.158	–10.896	–0.180	–6.731	–0.197	–13.393
HLTHPRAC	0.082	27.417	0.078	32.747	0.073	17.388	0.083	35.291
HLTHEXCE	0.535	28.039	0.408	26.103	0.444	16.339	0.343	22.397
HLTHGOOD	0.597	29.909	0.460	27.892	0.556	19.709	0.403	24.721
HLTHFAIR	0.579	33.009	0.449	31.458	0.520	20.788	0.369	26.848
EDU	–0.675	–5.248	–1.002	–10.785	–0.613	–3.760	–0.656	–6.692
LIFEINSU	0.000	1.912	–0.000	–1.449	0.000	1.684	–0.000	–6.191
POP1M	–0.045	–2.465	–0.082	–4.587	–0.058	–1.949	–0.007	–0.377
POP150	–0.051	–3.509	–0.074	–5.980	–0.070	–3.253	–0.081	–6.139
POP50	0.106	4.558	0.131	8.265	0.061	2.132	0.119	7.200
POPCUNTY	0.168	10.613	0.231	19.338	0.157	7.361	0.293	23.647
R^2	0.1810		0.1319		0.1877		0.1000	
Log-likelihood	–39,225.6		–60,556.9		–19,216.9		–58,513.5	
N	73,563		101,066		38,414		93,106	

Note: All regressions include the eleven regional dummies.

[a]Coefficients are significant at the 1 percent level, 5 percent level, and 10 percent level if the asymptotic *t*-statistics are greater than 2.576, 1.960, and 1.645, respectively.

is the breadwinner (BREADWIN) or the highest income earner in a household, he or she has a higher probability of having a health checkup, regardless of the type of health insurance held. This may arise because of the breadwinner's heavy responsibilities to the household.

People with NHI tend to be self-employed, farmers, part-time workers, professionals such as medical doctors and lawyers, who run their own offices, and the like. The estimates on the variables SIZE1000 to SIZE30 may be somewhat inconsistent in the NHI sample. It must be kept in mind, however, that there are quite a number of people working in large firms on a temporary basis. The statistically significant estimated coefficients for the SIZE variables in this subsample may be explained by the fact that workers in large firms have more opportunities to have checkups, regardless of their insurance coverage. In such cases, people with NHI are probably not using their health insurance to get checkups. Instead, most of the health checkup costs are borne by the employers, who run on-site medical offices. Thus, employees in large firms who are covered by NHI have greater accessibility to medical facilities for health checkups compared to those who are simply covered by NHI.

The estimated coefficient on LIFEINSU for the entire sample, reported in table 10.8, is significantly negative. Table 10.11 reveals, however, that it is significantly positive under ASOCHI (health insurance managed by associations for employees working in relatively large firms) and MUTUHI (Mutual aid associations for public employees and personnel in private schools).

Finally, we examine the demand for health checkups by size of institution, as shown in table 10.12. The sign of each explanatory variable is largely consistent across institution size, but the significance varies widely. On average, the results are more robust in institutions with ninety-nine or fewer employees. This may be due to the fact that employees in relatively small institutions have a greater ability to choose whether to have a health checkup. In other words, small institutions may not be providing adequate opportunities for their employees to obtain checkups, and they are not required to do so by law. Therefore, the health checkup decision is left largely to the employee's discretion.

10.5.3 Results for Patient Hospital Stays

The previous section focused on how individual characteristics affect the demand for health checkups. The regression results revealed that a large number of socioeconomic and demographic variables are significant in the health checkup decision. Here, we extend this analysis to explain the probability of being a patient in a hospital and, if admitted, the length of hospitalization. The dependent variables used in this section are PATIENT (a dummy variable indicating hospitalization) and HOSPITAL (length of

Table 10.12 **Dependent Variable: Health Checkup by Size of Enterprise**

	1000+ Employees Probit		500–999 Employees Probit		100–499 Employees Probit		99 Employees or Less Probit	
Variable	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
C	–2.039	–4.986	–1.744	–2.848	–1.531	–4.817	–1.106	–11.497
MALE	–0.046	–0.675	0.181	1.919	0.197	4.131	–0.040	–2.197
AGE	0.071	4.354	0.071	2.864	0.062	4.845	0.038	11.967
AGESQ	–0.001	–4.038	–0.001	–2.476	–0.001	–4.296	–0.000	–8.216
MARRIED	0.067	2.324	0.099	2.320	0.091	4.026	0.048	4.797
WAGE	0.008	0.135	–0.153	–1.685	–0.102	–2.119	–0.041	–2.127
BREADWIN	0.181	5.451	0.167	3.603	0.019	0.765	0.070	6.489
MONTHEXP	0.000	1.580	0.000	0.993	0.000	0.670	0.000	1.693
MOEXPDUM	–0.181	–4.332	–0.187	–2.831	–0.164	–4.422	–0.113	–6.291
ASOCHI	0.122	3.881	0.292	5.366	0.220	7.729	0.489	36.968
GOVTHI	–0.062	–1.507	0.181	3.161	0.140	5.158	0.393	39.573
DOCTOR	–0.000	–0.310	–0.000	–0.025	–0.001	–1.388	0.000	0.768
PROFES	0.053	1.756	0.051	1.055	0.084	3.113	0.143	10.760
ADMINI	0.179	4.303	0.118	1.710	0.173	4.098	0.180	6.375
CLERIC	0.104	3.550	0.028	0.621	0.115	4.649	0.104	8.463
SALES	0.073	1.861	0.065	1.099	–0.030	–0.0973	–0.120	–8.634
SERVIC	–0.022	–0.521	–0.011	–0.186	–0.115	–3.813	–0.139	–10.320
SECURI	–0.017	–0.150	–0.432	–2.220	0.091	0.775	0.093	1.368
TRANSP	0.044	0.928	–0.056	–0.672	–0.044	–1.066	0.011	0.523
SICKNUMB	0.130	7.844	0.148	5.678	0.144	10.768	0.131	20.537
STRESS	0.101	13.950	0.066	6.078	0.090	15.391	0.040	14.359
NOTVISIT	–0.162	–4.258	–0.074	–1.314	–0.139	–4.624	–0.119	–8.279

(*continued*)

Table 10.12 (continued)

Variable	1000+ Employees Probit		500–999 Employees Probit		100–499 Employees Probit		99 Employees or Less Probit	
	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
HLTHPRAC	0.095	16.261	0.082	8.843	0.087	17.673	0.072	31.265
HLTHEXCE	0.660	18.696	0.663	11.586	0.544	17.836	0.403	26.098
HLTHGOOD	0.758	20.502	0.719	11.900	0.613	18.935	0.447	27.338
HLTHFAIR	0.752	22.793	0.701	13.278	0.592	21.079	0.433	30.011
EDU	–0.626	–2.328	–0.027	–0.067	–0.338	–1.684	–0.826	–9.216
LIFEINSU	0.000	1.255	–0.000	–1.096	–0.000	–0.388	–0.001	–6.929
POP1M	0.018	0.513	–0.070	–1.188	–0.107	–3.141	–0.059	–3.453
POP150	0.004	0.148	0.008	0.174	–0.031	–1.262	–0.057	–4.786
POP50	0.137	2.836	0.068	0.980	0.078	2.322	0.084	5.527
POPCUNTY	0.095	3.096	0.126	2.660	0.130	5.351	0.195	16.948
R^2	0.0844		0.0765		0.0737		0.0959	
Log-likelihood	–10,053.3		–4,092.7		–14,434.2		–66,413.0	
N	24,787		8,589		28,375		104,840	

Note: All regressions include the eleven regional dummies.

[a]Coefficients are significant at the 1 percent level, 5 percent level, and 10 percent level if the asymptotic *t*-statistics are greater than 2.576, 1.960, and 1.645, respectively.

hospitalization in months).[26] The results shown in table 10.13 are from the second stage of a two-stage least squares (2SLS) regression. There are seven endogenous variables, from CHECKUP through CHEK1. For example, the variable CHEK1000 is the product of CHECKUP and SIZE1000.[27] In the discussion that follows, we focus on the estimated coefficients of these endogenous variables.

First, in the regressions using PATIENT as the dependent variable, the estimated coefficient on CHECKUP is highly significant and negative (–9.014).[28] The product terms are all negative, with CHEK1000, CHEK500, and CHEK5 being statistically significant. Thus, having a health checkup in an institution of one of these sizes reduces the probability of becoming ill and being hospitalized. On the other hand, individuals in institutions from SIZE1000 to SIZE30 who do not have a health checkup have a higher probability of becoming ill. Therefore, if institutions want to reduce their inpatient medical expenditures, they should encourage their employees to have health checkups on a regular basis. However, because the provision of health checkups does entail certain costs, the long-run cost-effectiveness of this policy is unknown.

Second, the effect of health checkups on HOSPITAL (tobit) is similar to that on PATIENT. CHECKUP is highly significant, and the negative sign indicates that individuals who have health checkups experience shorter hospital stays. The estimated coefficients on the product terms are all negative, and they are statistically significant for CHEK1000, CHEK5, and CHEK1. Combined with the positive estimated coefficients on SIZE1000 to SIZE5, these results suggest that, conditional on hospitalization, individuals who do not have health checkups will probably have longer hospital stays. To examine the robustness of the effect of CHECKUP on HOSPITAL, we estimate another HOSPITAL equation that takes into account the selection bias. The results obtained from the bias-corrected regression, HOSPITAL (OLS robust), are qualitatively quite similar to those obtained from HOSPITAL (tobit). The selectivity bias term (the estimated coefficient on the inverse Mills ratio variable) is –0.015 and highly statistically significant. The negative sign of the selectivity bias term indicates that individuals who have health checkups experience shorter lengths of hospitalization, on average, than those who do not.

The bottom of table 10.13 includes several additional statistics com-

26. For brevity, we do not report summary statistics for the independent variables in table 10.13. However, the mean, standard deviation, minimum, and maximum values of PATIENT are 0.005, 0.073, 0, and 1, respectively; for HOSPITAL, they are 3.088, 2.925, 0, and 12, respectively. Patients with hospital stays longer than one year are excluded from the sample. Including all inpatients would mean including an observation with a value of 687 months. The censored sample is more appropriate for this study.

27. The omitted variable under firm size is PUBEMPLY.

28. Since the endogenous variables are all predicted values from the first stage of the probit model for health checkups, the values are neither 0 nor 1, but decimal values.

Table 10.13 Probit, Tobit, and OLS Estimates of Patient Status (2SLS) and Hospital Status (2SLS)

	PATIENT Age 30–60 Probit		HOSPITAL Age 30–60 Tobit		HOSPITAL Age 30–60 OLS (Robust)	
Variable	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]	Coefficient	*t*-statistic[a]
C	–2.580	–3.833	–26.959	–4.385	0.068	2.697
CHECKUP	–9.014	–23.727	–59.949	–15.021	–0.266	–8.402
CHEK1000	–2.060	–4.342	–13.913	–3.381	–0.091	–2.203
CHEK500	–1.133	–1.827	–8.052	–1.525	–0.006	–0.165
CHEK100	–0.544	–1.272	–2.509	–0.680	–0.037	–1.034
CHEK30	–0.518	–1.192	–4.331	–1.147	–0.014	–0.417
CHEK5	–1.086	–2.327	–7.092	–1.748	0.029	0.940
CHEK1	–1.164	–1.265	–24.867	–2.185	0.088	2.564
SIZE1000	3.339	10.652	22.284	7.816	0.114	3.285
SIZE500	1.992	5.063	13.729	4.039	0.029	0.911
SIZE100	1.445	5.595	8.774	3.841	0.050	1.743
SIZE30	0.630	2.569	4.498	2.103	0.012	0.469
SIZE5	–0.418	–1.789	–2.962	–1.458	–0.046	–1.948
SIZE1	–1.831	–5.973	–9.146	–2.998	–0.108	–4.447
PROFES	0.792	12.922	5.159	8.785	0.016	8.298
ADMINI	1.015	11.968	6.835	8.541	0.021	7.552
CLERIC	1.067	17.684	7.270	12.006	0.022	9.832
SALES	0.008	0.106	–0.422	–0.627	–0.004	–2.114
SERVIC	–0.041	–0.644	–0.635	–1.064	–0.004	–1.848
SECURI	1.318	8.683	8.886	6.457	0.035	4.687
TRANSP	0.394	5.402	3.166	5.023	0.007	2.200

MALE	0.542	7.716	3.065	4.913	0.006	2.529
AGE	0.186	7.753	1.422	6.327	0.004	5.274
AGESQ	–0.001	–4.219	–0.010	–3.984	–0.000	–2.503
MARRIED	0.213	4.609	1.641	3.845	0.006	3.332
MONTHEXP	0.001	2.923	0.009	2.545	0.000	1.530
MOEXPDUM	–0.368	–5.339	–3.026	–4.528	–0.009	–2.680
DOCTOR	–0.001	–1.100	–0.000	–0.030	–0.000	–0.122
EDU	–1.260	–3.014	–10.773	–2.902	–0.049	–3.259
LIFEINSU	–0.002	–5.454	–0.011	–3.270	–0.000	–2.859
POP1M	–0.290	–4.093	–2.134	–3.261	–0.004	–1.819
POP150	–0.297	–5.589	–1.694	–3.522	–0.004	–2.725
POP50	0.182	2.435	0.856	1.227	0.005	2.939
POPCUNTY	0.871	16.570	6.132	11.660	0.022	9.979
SIGMA	—	—	7.458	24.329	—	—
Inverse Mills ratio	—	—	—	—	–0.015	–15.175
R^2	0.092		—		0.01366	
F-Statistic	—		—		47.9938	
Log-likelihood	–2,938.20		–2,888.69		–8,161.42	
F-statistic, instrumented regression	1,545.66 (d.f. = 15,310081)		—		—	
Basmann *F*-Statistic	641.72 (d.f. = 8,156300)		129.86 (d.f. = 8,155942)		—	
Hausman Chi-square statistic	12,669.05 (d.f. = 8)		9,789.87 (d.f. = 8)		—	
Hausman *F*-Statistic	2,188.48 (d.f. = 7,156307)		243.53 (d.f. = 7,155949)		—	
N	156,352		155,994		155,994	

Note: All regressions include the eleven regional dummies.

[a]Coefficients are significant at the 1 percent level, 5 percent level, and 10 percent level if the asymptotic *t*-statistics are greater than 2.576, 1.960, and 1.645, respectively.

puted for these models. In the reduced form equation to estimate CHECKUP,[29] there are fifty-two instruments in total, thirty-seven of which (including the eleven regional dummies and the seven endogenous variables) are included in the structural model of PATIENT. Therefore, there are fifteen predetermined variables that do not appear in the structural model; health-related variables such as SICKNUMB to HLTHFAIR are excluded from the PATIENT model because their inclusion in the second stage would make the estimation singular.[30] The *F*-ratio (instrument) for the fifteen instruments under PATIENT is 1545.66 with d.f. = (15, 310081), which indicates that the instruments as a set are statistically significant.

Next, we test for the validity and relevance of the instruments. We use two types of tests: the Basmann test (1960) and the Hausman test (1983, 433). The regression results reported in table 10.13 pertain to employees working in establishments classified as SIZE1000 to SIZE1 or PUBEMPLY, with a sample size of 156,352. The statistics are Basmann *F*-ratio = 641.72 (d.f. = 8, 156300) and Hausman Chi-square = 12669.05 (d.f. = 8), both of which are statistically significant.[31] Hence, the fifteen omitted instruments are statistically valid in the first-stage estimation of health checkups.[32]

Finally, we test the exogeneity of the seven endogenous variables, CHECKUP to CHEK1, and determine whether they belong in the structural PATIENT model.[33] The Hausman *F*-ratio = 2188.48 (d.f. = 7, 156307) rejects the null hypothesis to exclude. The Hausman *F*-ratio = 243.53 (d.f. = 7, 155949) is also statistically significant for the HOSPITAL model.

To summarize, health checkups (CHECKUP) play an important role in both the PATIENT (the probability of being an inpatient) and HOSPITAL (the length of stay in hospital) models. An individual who undergoes health checkups has a much lower risk of being hospitalized than one who does not. Furthermore, hospital stays are shorter for individuals who have the checkups.

29. The sample size is 310,134 in the first stage, as shown for age thirty to sixty in table 10.8.

30. If the omitted variables are significantly correlated with other independent variables, there may be omitted variables bias. However, we are more concerned with the effects of the endogenous variables on the dependent variable PATIENT. By definition, the estimated values of endogenous variables are orthogonal to the residuals.

31. The degrees of freedom (8, 156300) for Basmann's test is obtained using the following formula: The numerator (i.e., 8) is the total number of excluded predetermined variables from the second-stage estimation (the PATIENT equation), minus the number of endogenous variables (i.e., 15 – 7), and the denominator (i.e., 156300) is the total number of observations in the second-stage estimation minus the total number of predetermined variables in the first-stage estimation (i.e., 156352 – 52).

32. The same processes are also applied to the estimation of the HOSPITAL equation in table 10.13.

33. This procedure is explained in Gujarati (1995, 672–73).

Table 10.14 Marginal Effects of Health Checkups on Patient Status (Probit) and Hospital Status (Tobit)

Variable	PATIENT Age 30–60 Probit	HOSPITAL Age 30–60 Tobit
CHECKUP	–0.084	–0.048
CHEK1000	–0.019	–0.011
CHEK500	–0.011	–0.006
CHEK100	–0.005	–0.002
CHEK30	–0.005	–0.003
CHEK5	–0.010	–0.006
CHEK1	–0.011	–0.020

Note: Results are from table 10.13.

10.5.4 The Marginal Effects of Health Checkups on the PATIENT and HOSPITAL Models

The marginal effects of a health checkup (CHECKUP) on PATIENT and HOSPITAL are reported in table 10.14. The marginal effect of a health checkup on PATIENT is –0.084, whereas that on HOSPITAL is –0.048.

The –0.084 value indicates that a 10 percentage point increase in the prevalence of health checkups (CHECKUP) will decrease the probability of hospitalization by 0.84 percentage points. This effect is averaged over all individuals aged thirty to sixty. In addition to this basic effect, if the individual is an employee in a firm of SIZE1000, SIZE500, or SIZE5, there is an additional reduction in the probability of hospitalization of 0.1 to 0.2 percentage points for a ten-percentage point change in CHECKUP.[34] In other words, the probability of hospitalization is 1 percent lower for an individual who has had a health checkup.[35] At first glance, this may appear to be a negligible value, but from the standpoint of a typical firm, one out of every 100 employees may avoid hospitalization.

The marginal effect of health checkups (CHECKUP) on HOSPITAL is –0.048. This implies a reduction in hospitalization of about 0.15 months for an individual aged thirty to sixty who stayed in the hospital less than one year.[36] The coefficients on the product terms, CHEK1000 through CHEK1, are all negative. The marginal effects of CHEK1000, CHEK5, and CHEK1 are statistically significant (see table 10.13). For example, the –0.011 on CHEK1000 is equivalent to a reduction in the length of hospital stay of about 0.03 months (0.011 × 3.1 months), or about one day.

34. The estimated coefficients of CHECK1000, CHECK500, and CHECK5 are statistically significant, as shown in table 10.13.

35. Here, the interpretation is in terms of percents rather than percentage points because the original value of CHECKUP in the reduced-form equation is either 1 or 0.

36. The average length of hospital stay is about 3.1 months for persons aged thirty to sixty who stayed in the hospital less than one year. The 0.15 month figure (4.5 days per month) is obtained by multiplying 0.048 by 3.1.

These reductions are substantial in light of hospital costs, opportunity costs, and psychological costs. Consider employed survey respondents who were hospitalized in May 1995 as an example. The average monthly out-of-pocket cost for individuals aged thirty to sixty is about $420 ($1 = 100 yen). Average monthly out-of-pocket cost for individuals aged thirty to sixty is approximately $1,100.[37] Since these individuals are employees in firms, they must be covered by health insurance managed by associations or health insurance managed by the government. Thus, the costs paid by the individuals reflect only 20 percent of total hospital costs. The other 80 percent is borne by the Social Insurance Medical Care Fee Payment Fund. Therefore, total hospital costs must be about $2,100 per month or $5,500 per month for thirty- to fifty-year-olds and thirty- to sixty-year-olds, respectively.

The reduction in the length of hospital stay due to health checkups translates into a reduction in hospital costs. On an individual basis, the reduction in hospitalization by 0.15 months, or 0.18 (= 0.15 + 0.03) months when firm size is taken into account, reduces hospital expenditures by $315 ($2,100 × 0.15) per case for a hospitalized individual aged thirty to fifty and $825 ($5,500 × 0.15) per case for a hospitalized individual aged thirty to sixty. About $70 to $190 may be added to these figures if the effect of the product term of health checkup and firm size, CHEK1000, is taken into consideration.[38]

In comparison to these costs, a thorough, in-hospital medical examination (i.e., a health checkup) costs only $365 (see section 10.2). Furthermore, an individual's out-of-pocket expenses for additional tests are minimal due to local government subsidies. These figures suggest that health checkups are highly cost-effective in the long run. Therefore, health checkups should be widely encouraged as a method of illness prevention.

10.6 Summary and Conclusion

This study investigates the demand for health checkups among the working population in Japan. According to the *1995 National Survey of Life* (Statistics and Information 1998), the health checkup rate of the twenty- to sixty-four-year-old population is about 56 percent. The analysis

37. The averages are from costs paid by individuals who were hospitalized during the month of May 1995. In terms of Japanese yen, the values are about 41,600 yen for individuals aged thirty to fifty and about 111,200 yen for those aged thirty to sixty.

38. The marginal effect of the product term of health checkup and firm size, CHEK1000, is –0.011. Therefore, savings can be calculated as $72 = (0.011 × 3.1 months × $2,100 per month) for thirty- to fifty-year-olds, and $188 = (0.011 × 3.1 months × $5,500 per month) for thirty- to sixty-year-olds. Patients with hospital stays longer than one year are excluded from the sample. Inclusion of all inpatients would mean including an observation with a value of 687 months. The censored sample is more appropriate for this study.

focuses on the thirty-to-sixty age group for two reasons: first, this age group is more homogeneous than the twenty-to-sixty-four age group; second, sixty is generally the retirement age for employees in Japan. The empirical results have direct policy implications for the prevention of illness among the working population. These results pinpoint specific policies that firms can implement to improve employee health and help contain growing medical expenditures.

The individual's health checkup decision is explored using a probit model, which is estimated separately by age group, gender, type of health insurance, and firm size. The major explanatory variables of interest include age, gender, wage rate, health insurance coverage, affiliated firm size, and objective evaluations of the individual's health condition. We also examine the effects of an individual's health checkup status on his or her probability of hospitalization and the subsequent length of hospital stay.

Most of the estimated coefficients of the aforementioned variables have the theoretically predicted signs and are highly significant determinants of the demand for health checkups. The estimated coefficients on age and age-squared are positive and negative, respectively, reflecting that the incentive to have a health checkup increases at a diminishing rate with stock of health. Because stock of health increases with age, as does earning ability, the incentives for having a health checkup also increase. Gender also plays an important role in the individual's decision to have a health checkup. Due to genetic and biological differences, males are more likely to have health checkups than females.

A health checkup is a time-consuming health input. For this reason, the opportunity cost of work hours or days is a major determinant of the health checkup decision. The sign of the individual's wage rate is negative and highly significant in the probit models, and the magnitude is largest for the thirty-to-thirty-nine age group. Given the negative effect of NHI on health checkup rates, the positive and significant effects of health insurance managed by associations, health insurance managed by the government, and mutual aid associations insurance reveal that individuals are more willing to have checkups when coverage is more generous. Furthermore, larger enterprises do more to encourage their employees to get health checkups than do smaller enterprises. Thus, in order to promote health checkups among employees and consequently in the population as a whole, a public policy that lowers the opportunity cost of health checkups for targeted groups of working people is desirable.

The estimated coefficients on the individual's objective health conditions are statistically robust. The more illness (and stress) an individual faces, the more likely he is to have a health checkup. On the other hand, if an individual has not visited clinics or hospitals for the past year, which we take to reflect a higher stock of health, he is less likely to have a health checkup, ceteris paribus. Therefore, promoting individuals' health stock, by providing better working conditions and reducing work stress, for instance, may help to contain the increase in medical expenditures.

In the short run, health checkups increase medical expenditures. These expenditures are offset, however, by reductions in the incidence and duration of hospitalization. Using 2SLS on the sample data, we find a significantly negative and robust health checkup effect on these measures. In other words, an individual who has had a health checkup has a much lower risk of being hospitalized than one who has not. Furthermore, if this individual is hospitalized, he is likely to have a shorter hospital stay. Thus, in the long run, checkups will reduce not only monetary expenditures but also psychological burdens associated with illness and hospitalization.

The point estimate of the effect of health checkups on the probability of hospitalization suggests that a 10 percentage point increase in the health checkup rate will reduce the probability of hospitalization by 0.8 percentage points. This is the base effect of an individual health checkup; the effect varies by firm size, and one important finding is that checkups may prevent hospitalization for one out of every 100 employees in large firms.

As for length of hospital stay, a 1 percentage point increase in the health checkup rate reduces stays by 0.15 months per year for the thirty-to-sixty age group. Adding in the effects associated with firm size reduces the average stay by an additional 0.03 months. Without the firm-size effects, these reductions translate into cost savings of \$315 for individuals aged thirty to fifty and \$825 for individuals aged thirty to sixty. The firm-size effects reduce costs further by \$70 to \$190 per month. These approximate monetary calculations are based solely on hospital costs paid by both the individual and the health insurance agency. If psychological and opportunity costs were incorporated into this analysis, total benefits would far surpass monetary savings.

To conclude, this paper finds that health checkups constitute a highly cost-effective means of illness prevention within the context of the current comprehensive system of national health care. We must increase the relatively low health checkup rate of 56 percent in the twenty-to-sixty-four-year-old population, if only because good health is, by itself, of great value.

Appendix

$$\{[1 - \pi(A)]U_{xx} + \pi(A)U_{yy}[1 + \pi_h^* L(A, H)]) < 0.$$

From the first-order optimal condition of equation (11), we have

$$-[1 + \pi_h^* L(A, H)] = \frac{[1 - \pi(A)]U_x(x)}{\pi(A)U_y(y)}.$$

Since the right-side of the above equation shows the slope of the indifference curve (Ehrlich and Becker 1972, 626), we can express this as follows:

$$\text{MRS} = -\frac{[1 - \pi(A)]U_x(x)}{\pi(A)U_y(y)}.$$

By partially differentiating the optimal condition with respect to P, the results are found to be

$$\frac{\partial \text{MRS}}{\partial P} = -\frac{1}{[\pi(A)U_y(y)]^2}\{\pi(A)U_y(y)[1 - \pi(A)]U_{xx} - [1 - \pi(A)]U_x\pi(A)U_{yy}\} > 0,$$

which implies

$$\left\{[1 - \pi(A)]U_{xx} - \frac{[1 - \pi(A)]U_x}{\pi(A)U_y(y)}\pi(A)U_{yy}\right\} < 0.$$

This is also expressed as

$$\{[1 - \pi(A)]U_{xx} + [1 + \pi_h^* L(A, H)]\pi(A)U_{yy}\} < 0.$$

Thus, we obtain

$$\{[1 - \pi(A)]U_{xx} + \pi(A)U_{yy}[1 + \pi_h^* L(A, H)]\} < 0.$$

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