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Morbidity Valuation with a Cessation Lag

Choice Experiments for Public- and Private-Goods Contexts in Japan

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RESOURCES FOR THE FUTURE

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Abstract

We conducted a choice experiment presenting respondents with risk reductions for three types of illnesses related to air pollution—pollen allergy, chronic bronchitis, and lung cancer—splitting the sample to test the effects of private-good and public-good contexts on the value of a statistical case (VSC) of each illness type. The results indicate that pollen allergy would be valued less than chronic bronchitis, which would be valued less than lung cancer. In terms of the private/public goods context, when exogenous rates of time preference/discount rates were applied to the estimation procedure, the VSC for a specific illness almost always was larger for the public-goods context. However, because estimated rates of time preference are far larger in the private-goods context (17% versus 1.3%), the benefits are lower, and, as they are the denominator in the VSC calculation, the VSCs are larger. We also find some effects that could be attributed to paternalistic altruism on the rate of time preference, as well as on willingness to pay for illness risk reduction. For instance, respondents with children were willing to pay more for pollen allergy risk reduction than respondents without children but less for lung cancer in the public-goods context.

Key Words: morbidity, valuation, choice experiment, Japan

JEL Classification Numbers: H41, I12, I18, J17

Contents

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Objectives and Background

Air pollution is still one of the most serious environmental issues in Japan, despite the progress that has been made in reducing ambient concentrations. However, as with so many measures taken to reduce air pollution, further reductions are likely to be more costly. Therefore, it is important to understand the preferences of the public for further reductions. As air pollution reductions will improve health, we need to understand how much health improvements are valued.

Much attention has been paid to understanding the willingness to pay (WTP) for mortality risk reductions (see, for example, Kochi et al. 2006). But morbidity risk reductions have been much less well studied, particularly with respect to cancer and chronic lung disease. In Japan, the literature is particularly thin. Moreover, reductions in the risk of diseases such as cancer and lung disease will not be realized immediately upon reductions in air pollution; thus, this "cessation lag" needs to be taken into account because individuals may discount such benefits if they occur in the future. A further element in the literature that has not been well studied is the contrast between the WTP for health improvements that only help oneself, such as through the purchase of a market good, and measures that help the overall community, through the purchase of a public good. The WTP for both types of goods may be relevant depending on the type of policy at issue.

The purpose of this study is to estimate the WTP for risk reductions in three major kinds of illness—pollen allergy, chronic bronchitis, and lung cancer—related to air

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pollution using the choice experiment method, accounting for cessation lags and offering sub-samples of individuals identical surveys except for the commodity delivering the improvements, which may be either a public or private good.

Consideration of Illnesses to Be Analyzed

Table 1 lists selected studies that examine the link between air pollution and the three diseases studied in this paper. There is a large literature linking air pollution to various respiratory diseases. We selected chronic bronchitis as a representative endpoint because no valuation study has been carried out for this endpoint in Japan. Note that there are estimates available for Japan on the WTP for reductions in acute respiratory illness, although the sample is small (Akai and Itaoka 2001).

Table 1. Selected Studies on Air Pollution and Related Diseases

Disease category	*Endpoint of disease*	*Exposure impact substance*	*Significant relation in epidemiologic study*	*Main study*
Respiratory disease	Chronic Bronchitis	PM_{10}, $PM_{2.5}$, Nitrates, Sulfates	Proved statistically significant relationship	Abbey *et al.* (1993, 1995)
	Acute asthma attach	PM_{10}, $PM_{2.5}$, Nitrates, Sulfates		Whittemore and Korn (1980) McDonnell *et al.* (1999)
	Respiratory hospital admission	PM_{10}, $PM_{2.5}$, Nitrates, Sulfates, O_3		Burnett *et al.* (1997) Thurston *et al.* (1994) Schwartz (1995)
	Emergency room visits	PM_{10}, $PM_{2.5}$, Nitrates, Sulfates, O_3		Schwartz (1993)
	Acute respiratory symptoms	PM_{10}, $PM_{2.5}$, Nitrates, Sulfates		Krupnick *et al.* (1990)
	Restricted activity days	PM_{10}, $PM_{2.5}$, Nitrates, Sulfates		Ostro (1987)
Cancer	Leukemia	Benzene		WHO (1996a)
	Lung cancer	DEP	Partially proved statistically significant relationship	WHO (1996b)
Allegy	Allergic rhinitis symptoms (pollen allergy, etc.)	DEP		Kobayashi *et al.* □ 2000□

As for carcinogenic risk, Table 1 shows epidemiological evidence of the link between benzene exposure and leukemia, while a link between diesel exhaust particles (DEP) and lung cancer has been suggested but not fully proven (Study Panel on Risk Estimation of DEP 2002). Finally, the report by the Investigative Committee on Correlation between Emission Gas Exhausted by Diesel Vehicle and Pollen Allergy (2003) suggests that DEP may cause and worsen pollen allergy symptoms.[1] We chose pollen allergy as one of the illnesses to be subject to the evaluation because the committee believes that the potential damage by air pollution could be hug

Literature Review

The relevant literature is any studies addressing the WTP for morbidity reduction, either for the specific diseases addressed or for other diseases related to air pollution, addressing valuation in public versus private goods contexts and addressing latency/cessation lag (which would include the literature on the rate of time preference).

In terms of valuing diseases, we found no studies addressing the value of avoiding the condition of pollen allergy. There is a small literature providing estimates of the value of a statistical case (VSC) of chronic bronchitis (Krupnick and Cropper 1992; Viscusi et al. 1991). These studies used an elicitation method of driving respondents to a point of indifference in choosing to live in one of two cities offering different tradeoffs between chronic bronchitis and the cost of living and, separately, accidental death and the cost of living. Neither latency nor public goods valuation were addressed. As used by the U.S. Environmental Protection Agency in its Regulatory Impact Analyses, these studies imply a VSC of about $260,000 relative to a value of statistical life (VSL) estimated in these studies between $1 and $2 million.

While much public attention has been given to cancer, few studies have estimated the WTP to avoid it. Those that have provide a mixed message. In terms of cancer mortality, Hammit and Liu (2004), Sunstein (1997), Savage (1993), Mendeloff and Kaplan (1989), and Jones-Lee et al. (1985) find for a public good that the value of preventing

[1] DEP in the blood of a pollen allergy patient and in a test tube has been found to generate and increase substances causing and worsening allergy symptoms.

cancer mortality exceeds the value of preventing death due to other diseases and/or fatal accidents. On the other hand, Adamowicz et al. (2005) find in a public goods case no statistical difference between the value of preventing death from cancer and death from a microbiological disease in the context of drinking water improvements. Similarly, Magat et al. (1996) found indifference between equal reductions in the probability of fatal lymph cancer and fatal car accident.

The economic valuation literature also is very limited with respect to cancer morbidity or the entire cancer lifecycle[2] and, as one would expect, even more limited with respect to valuation of lung cancer risk reductions. Adamowicz et al. (2005) estimate the WTP for avoiding bladder cancer from improved drinking-water quality using the contingent valuation approach and find a mean household WTP of $160 for a reduction of 50 bladder-cancer cases and a reduction of 10 deaths from bladder cancer (over 35 years) in a population of 100,000. This translates into a VSC involving a 20 percent mortality rate over 35 years of $11 million. Using a choice experiment approach, they found that the WTP for preventing one cancer death was $10 per year and for preventing one cancer case was about $2 per year. These translate into VSLs and VSCs of about $13 million and $3 million, respectively.

Tsuge et al. (2005) administered a choice-experiment survey in Tokyo to estimate WTP for mortality risk reduction from three causes of death: cancer, heart disease, and accidents. Using only the marginal WTP for a mortality risk reduction irrespective of cause of death, they obtain a VSL of 350 million yen (in 2002 Japanese yen, about $2.9 million). They also find a WTP premium for mortality risk reduction due to cancer over other causes of death but did not use this premium in their VSL calculation. They also estimate the rate of time preference (discount rate) based on respondents' preference over the trade-off between the cessation lag and cost. The estimated rate of time preference is 21 percent. In this study, the model to estimate VSL and the one to estimate the rate of time preference are different. When we calculate VSL using WTP and rate of time preference estimated in the

[2] Some studies have investigated the economic value of nonfatal cancer risk reductions applying approaches other than stated preferences; for example, Murdoch and Thayer (1990) used a revealed preference approach.

same model of their study, we find the VSL increases to 550 million yen. In the model presented below, we always estimate both in the same model.

Itaoka et al. (2007) conducted a contingent-valuation survey in Sizuoka, Japan, to estimate WTP for mortality risk reduction from an unspecified cause of death. The VSLs are from 103 to 344 million yen (in 1999 Japanese yen). They also estimated a rate of time preference (implied discount rate) by comparing the WTP for a current risk reduction and the WTP for a future risk reduction assumed to start at age 70. The estimate rate of time preference is 7 percent, with an average cessation lag of 19 years.

Studies explicitly addressing lung cancer and that apply stated-preference methods include Aimola (1998) in Department for Environment, Food and Rural Affairs (2004) and Kennedy (2002). Aimola (1998) estimates WTP for cancer risk reductions in Sicily for lung cancer (€50,000), uterine cancer (€90,000), prostate cancer (€500,000), and leukemia (€730,000). Adding ExternE cost of illness and forgone earnings estimate for non-fatal cancers to Aimola's WTP estimate for lung cancer, Department for Environment, Food and Rural Affairs (2004) approximates a total economic cost for lung cancer of £375,000 (£2003). Kennedy (2002) estimates individual WTP for a private good that would reduce domestic radon concentrations and, therefore, the risk of developing lung cancer. The author estimates and compares risk valuations obtained by applying both stated- and revealed-preference methods. The authors report estimates of the WTP for radon remediation using a revealed-preference approach ranging from £500 to £700, with an estimate of the VSL of approximately £180,000.

Turning to the more general morbidity literature, recent studies have made important contributions toward the development of better WTP estimates for health risk reductions. These studies have analyzed the influence of factors such as latency, age, type and cause of illness, and type of prevention and treatment program in individuals' WTP (Alberini et al. 2004; Ready et al. 2004; Cameron and DeShazo 2004; Cropper et al. 1994). However, the most relevant existing literature for the study at hand includes Hammitt and Liu (2004), DeShazo and Cameron (undated), and Strand (2001).

Hammitt and Liu's (2004) research is related to this study because they evaluate the effects of four different diseases, including fatal lung cancer and fatal bronchitis, and latency on WTP. Their results show that WTP to reduce latent fatal risk (where the symptoms and the consequent death are to be experienced 20 years later) is about onefourth smaller than WTP to reduce risk where the symptoms would be developed in the short term, followed by a fatal outcome.[3] In this study respondents are asked about their WTP for environmental programs that will reduce risks within the household (public goods within the household). This might be a misleading strategy, given that such programs are in reality public goods.

DeShazo and Cameron (undated) developed and tested an empirical model of individuals' intertemporal allocation of expenditures in programs to reduce mortality and morbidity risks regarding 12 different illnesses, including lung cancer and respiratory disease. Explicitly addressing the interaction between disease latency and individual discount rates, they produce estimates of the VSC[4] using information from a national survey in the United States.[5] Results show that latency effects vary across age groups and suggest a negative relationship between the current age of the respondent and WTP for health risk reductions but also suggest that individuals' WTP increases with the age at which adverse health risks would occur. Nevertheless, this study does not address differences in WTP between public and market goods.

Finally, Strand estimates VSLs for both public and private goods for heart disease. His results suggest that WTP for a public good may exceed WTP for the same good provided privately. In order to address the effect of altruism on VSL, the author splits the VSL into three valuation motives. Results show that about 30 percent of total public-good WTP is due to concern for one's own life, 50 percent for other family member's lives, and 20 percent for other persons or motives. Even though the questionnaire included choice experiments involving tradeoffs with respect to latency of program benefits and age groups in which lives are saved, the analysis of these issues is not presented in this paper. The results in this study support previous empirical studies that have found that WTP for public safety projects exceeds WTP for private safety devices (Jones-Lee et al. 1985; Viscusi et al.

[3] Respondents discount at a rate of about 1.5 percent per year for a 20-year latency period.

[4] VSC is defined as "the present discounted value of the stream of maximum annual payments that the individual would be willing to pay for the specified risk reduction, scaled up proportionately to correspond to a risk reduction of 100 percent."

[5] The core part of the survey is a conjoint choice experiment that presents hypothetical, specific illness profiles and mitigation programs.

1988). However, evidence is divergent, and other studies have found that WTP for a private good is higher than the WTP for a public safety program (Johannesson et al. 1996).

The literature regarding the elicitation of health-related intertemporal preferences is vast. One relevant study is the research of Van der Pol and Cairns (2001), who elicit time-preference rates for nonfatal changes in health using discrete choice experiments in the United Kingdom. The authors compare time preferences with respect to one's own future health with time preferences regarding others' future health. Depending on the period of delay, the implied discount rates range from 5.5 to 9.1 percent for own health and from 7.8 to 14.7 percent for others' health, suggesting that time-preference rates for others' health are higher than the rates for own health. Even though the author does not discuss the possible implications of these findings regarding the economic value of life and health (perhaps a discussion out of the scope of this study), it could tentatively be inferred that the VSL for public goods could be lower than that for private goods. Results also show that implied discount rates are influenced by individuals' characteristics, such as age and self-rated health, particularly regarding own health. The authors claim that the estimated discount rates are comparable to other estimates using a discrete-choice approach: Horowitz and Carson (1990) 4.5 percent; Cropper et al. (1991) 2.7 to 8.6 percent; Cropper et al. (1994) 3.8 to 16.9 percent;[6] Johannesson and Johansson (1997a, 1997b) 1.3 percent and 1 percent, respectively; Johannesson and Johansson (1996) 8 to 25 percent. Finally, a new study (Alberini et al. forthcoming) used results from two contingent-valuation surveys conducted in Canada and the United States to explore the effect of a latency period on WTP for reduced, unattributed private-mortality risk using a structural model. They find that delaying the time at which the risk reduction occurs by 10 to 30 years reduces WTP by more than 60 percent for respondents in both samples aged 40 to 60 years. The implicit discount rates are equal to 3 to 8.6 percent for Canada and 1.3 to 5.6 percent for the United States.

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[6] Estimates from Cropper et al. (1994) actually are 3.4 percent and 16.8 percent, rather than 3.8 to16.9 percent. In their survey, the median respondent required 2.3 lives to be saved five years from now for every life saved now (a discount rate of 16.8 percent). For a 100-year horizon, the implied discount rate is 3.4 percent: the median respondent required 44 lives to be saved 100 years from now for every life saved now.

Survey Design

Survey Design Process

We designed two versions of the questionnaire: a private-goods version and a public-goods version. Six focus groups with six to eight participants each were held to test the various versions of the questionnaire. We found no serious problems for respondents to be able to understand and accept the public-goods version. In particular, we were concerned that respondents might include other benefits of air pollution mitigation in their definition of the "commodity" being valued; however, focus group results suggested otherwise.

For the private-goods version of the questionnaire, we originally tested a scenario where respondents were asked to assume they had a specific morbidity risk and then asked to assume they could reduce this risk to some extent by paying some money. That is, respondents were asked to assume that they were shown a doctor's diagnosis and then were asked if they would pay for a treatment program offered by the doctor. The diagnosis included several symptoms and explicit descriptions of their severity indicated by duration of home treatment and hospitalization but did not include the name of illness. This scenario had the advantage of allowing us to estimate the value of reducing risks associated with several types of illnesses at once. With this scenario, we thought we could estimate value of risk reduction of several symptoms of different severities and then calculate the value of reducing risks of different illnesses that could be synthesized from values on symptoms.

Through the focus groups experience, we found a problem with this scenario related to asking participants to hypothesize about both their baseline risk and the risk reduction, which was viewed as a difficult task by respondents and one they had trouble taking seriously. Further, respondents wanted illnesses named, not just described by symptoms. Thus, we developed the scenario we used in the survey, which asked respondents if they would purchase a hypothetical commodity to reduce several different types of illnesses from their actual baselines.

In addition, the focus group sessions revealed another problem. Even after we provided participants with basic information on the risk and severity of the three illnesses, some participants told us they did not take chronic bronchitis risk to themselves seriously (in the private goods context) compared to the risks from the other illnesses because they were not familiar with chronic bronchitis risk, there being few family or friends with the disease. On the other hand, pollen allergy was salient to them because they saw many miserable friends or colleagues, and the media often report on the widespread problems of pollen allergy. Their understanding about the quality of life and death risks from lung cancer likewise required little elaboration from us. However, in the public goods context, they based their WTP not only on benefits to themselves, but also to others; therefore, they were more interested in paying for reductions in chronic bronchitis risks so that others might benefit.

Finally, before the actual survey, we conducted pre-tests to examine the operability of the questionnaires and improve the attribute levels of the choice sets.

Design

Both the private-goods version and the pubic-goods version were designed with contexts involving tradeoffs among the three health effects and their cessation lags. Table 2 shows that we made a further differentiation in the survey design by distributing three different versions of the private-goods survey depending on whether the respondent was: a) up to age 49; b) a smoker of age 50 or older; or c) a nonsmoker of age 50 or older. Note that the "risks" in the public goods setting are for numbers of people who will become sick per a community of 10,000 people and that in both surveys the risks or numbers of illnesses are given for a 10-year period (to increase the percentages and numbers to more understandable levels) (see Krupnick et al. 2002). Table 3 provides the levels of attributes in the choice experiments planned by orthogonal design.

Table 2. Questionnaire Version and Baseline Risk of Three Diseases

Questionnaire version		Private 1	Private 2N	Private M2S	Public 1	Public 2
Context		Private goods			Public goods	
Respondents' characteristics		20s–40s	Nonsmoking 50s or older	Smoking 50s or older	20s or older	
Sample size (N)		327 (27.2%)	228 (19.0%)	155 (12.9%)	249 (20.7%)	244 (20.3%)
		710 (59.0%)			493 (41.0%)	
Conjoint questions		Six			Six	
Baseline risk						
	Pollen allergy	10%	10%	10%	1,000 persons*	1,000 persons*
	Chronic bronchitis	0.8%	2.8%	5.6%	200 persons*	100 persons*
	Lung cancer	0.1%	0.8%	1.6%	40 persons*	20 persons*

* in a community of 10,000

Table 3. Changes of Attributes in Choice Experiment

Attributes	Levels			
Private-goods context				
Cessation lag	0 years	2 years	5 years	10 years
Risk reduction of disease for 10 years:				
Pollen allergy	0%	0.5%	1.5%	4%
Chronic bronchitis	0%	0.1%	0.3%	0.6%
Lung cancer	0%	0.02%	0.05%	0.08%
Cost:				
For 20s–40s	2,400 yen	10,000 yen	36,000 yen	84,000 yen
For 50s-, nonsmoker	2,400 yen	10,000 yen	36,000 yen	84,000 yen
For 50s-, smoker	2,400 yen (4,000 yen*)	10,000 yen (12,000 yen*)	36,000 yen (48,000 yen*)	84,000 yen (96,000 yen*)
Public-goods context				
Cessation lag	0 years	2 years	5 years	10 years
Risk reduction of disease for 10 years in a community of 10,000:				
Pollen allergy	0 persons	50 persons	150 persons	400 persons
Chronic bronchitis	0 persons	10 persons	30 persons	60 persons
Lung cancer	0 persons	2 persons	5 persons	8 persons
Cost	4,000 yen	12,000 yen	48,000 yen	96,000 yen

Note: Each row is independent from other rows

*53 respondents (34.2 percent of over 50s and smoker respondents of private-goods context) were offered these figures.

The public-goods version of the survey begins with demographic questions. Part 2 is the information treatment. The survey says that a new government program is being contemplated to reduce air pollutants and that households will be paying a share through increased taxes. While this type of description, particularly evoking air pollution, would induce free riding, protest bids and the like from an American sample, focus groups and the experience of the researchers reveal that these are not issues for most Japanese respondents.

The text goes on to say that "the community would benefit by lowering new cases of three diseases: pollen allergy, chronic bronchitis, and lung cancer that are partially caused by air pollutants, although the benefits would take a few years to be realized." Then actual average baseline disease rates for a Japanese community of 10,000 people are described for a 10-year period (to keep the numbers manageable, particularly in the private good case). Then tables and bullets are used to describe the diseases in terms of average duration of illness, death risks, typical symptoms and how long they persist, and treatment and effects on quality of life.

In Part 3, the respondent is exposed to the conjoint screen set up (Figure 1 in the appendix) with the diseases, cessation lags (just termed "latency"), and cost in taxes as attributes. New cases in a community of 10,000 people over 10 years are given for the status quo and two programs. For the programs, the reduction in new cases from the status quo also is given. Note the use of color to highlight cells where the status quo does not change. To help the respondent understand latency and the time phasing of taxes and improvements, a figure is included (Figure 2 in the appendix), as in Krupnick et al. (2002). Also, graphs with 10,000 squares with red for new cases and blue showing the reduction in new cases are given as examples to fix understanding of the size of the risks and risk reductions (Figure 3 in the appendix, again, as in Krupnick et al. 2002). At this point, respondents are asked if they believe that the stated effects will occur and, if they say no, they are asked to assume that such effects would occur. They also are reminded that the programs reduce risks to people in the community, including the respondent. They also are told that if not enough tax is collected, the program will not go into effect. This section closes with a practice and learning section. Huber (2004) shows that responses to initial conjoint questions are unstable. Hence, we use this question to induce familiarity with the set-up. In addition, as we designed the screen with a dominate program choice, we can use a wrong response (choosing the dominated program instead of the status quo or the dominant program) as an opportunity for learning by explaining to the respondent why this choice was problematic. Then these respondents are asked to make another practice choice.

Part 4 contains six conjoint questions. Finally, Part 5 asks debriefing questions concerning understanding of the survey; how much their choice was influenced by benefits to themselves, family members and others; questions about choice motives for those answering the status quo each time; and questions to identify whether the tax vehicle and the government program per se led to biases. The survey closed with some additional demographic questions.

The private-goods survey was as identical to the public-goods survey as possible, with the following exceptions. The private-goods version asked about actions the respondent takes to improve his or her health; the information section contained education material on the concept of chance; and the agent for affecting health improvement was an abstract “product or service” “that has been tested and proved reliable by respected research institutes.” Of course, rather than a tax, the payment vehicle was the cost of the product or service.

Survey Implementation and Respondents’ Attributes

Implementation

We administrated the survey to 2,726 adults residing in Central Tokyo (23 wards) and Osaka City in September and November 2004. These two cities were selected for this survey because they are the central areas covered by the automobile NOx PM law[7] in Japan. The sample was chosen at random from the resident list of Tokyo and Osaka, with permission of the local governments. The researchers then personally visited the selected people and asked them to participate in the survey. If they agreed, the researchers give them a brief explanation about the questionnaire and left it with them. Afterward (generally within a week), the researchers picked up the filled-out questionnaire. The participants were

[7] The Law Concerning Special Measures for Total Emission Reduction of Nitrogen Oxides from Automobiles in Specified Areas, Heisei 4 June 3, Law 70, Japan.

offered a merchandise coupon valued at 1,000 yen. This approach boosted the response rate above that of a standard mail survey (44.1 percent), producing 1,203 valid responses.

Respondents' Characteristics

Table 4 shows the descriptive statistics for respondents' attributes. Some differences between the private-goods and the public-goods samples include the ratio of males to females and average age. These differences were a consequence of recruiting a sufficient number of smokers in the private-goods questionnaire sample who were over age 50 and a smoker. In Japan, these skewed to males. With more males, we also see higher average baseline risks in the private-good sample. Thus, the public-goods sample is likely to be more representative than the private-goods sample. Even so, the public-goods sample has a higher ratio of females to males (57.8 percent) than the national average (51.1 percent) simply because response rates tend to be higher for females. As for age, our samples have a lower percentage of respondents in their 20s than the national average, probably because we did not recruit students (because they generally do not have discretionary income). Household size (3.4) is higher than the national average (2.83), mainly because response rates of one-person households were lower than larger households and because we did not recruit students. Income for our sample is midway between the average income of all households and the average income of workers' households. In addition to the reasons already mentioned, recruiting elderly people who depend on a pension also may lower average income in the sample.

Table 4. Descriptive Statistics of Respondents' Characteristics

	Unit	Market (N=710)	Public (N=493)	Pooled (N=1203)
Ratio of females to males * National average: 51.1**	%	52.5	57.8	54.7
Average age * National average: 48.9 ** (Average of people in age of 20-99 years old)	Years old	49.9	45.6	48.1
national average is in parentheses below				
20-29 years old (18.1%)	%	12.5%	16.6%	14.2%
30-39 years old (16.8%)	%	13.7%	20.3%	16.4%
40-49 years old (16.6%)	%	19.9%	27.2%	22.9%
50-59 years old (19.0%)	%	25.1%	16.6%	21.6%
60-69 years old (14.7%)	%	17.9%	10.8%	15.0%
70-79 years old (10.0%)	%	10.0%	7.5%	9.0%
Over 80 years old (4.8%)	%	1.0%	1.0%	1.0%
Average number of persons in household * National average All households: 2.72† Workers' households: 2.83‡	Persons	3.4	3.4	3.4
Ratio of respondents who have one or more children	%	70.1	65.3	68.2
Average years of education	Years	12.9	13.0	12.9
Share of respondents' occupation				
Company employee	%	29.3	29.0	29.2
Self employed	%	21.1	15.2	18.7
Engaged in agriculture, forestry, or fishery	%	0.0	0.0	0.0
Public officer of teacher	%	3.4	2.8	3.2
Student	%	3.0	3.4	3.2
Part-time job	%	14.4	17.8	15.8
Unemployed (including homemaker)	%	27.0	29.4	28.0
Others	%	1.8	2.2	2.0
Ratio of respondents who live in Osaka city	%	49.9	48.3	49.2
Total combined household income				
0-2 million yen	%	11.8	8.3	11.6
2-4 million yen	%	18.9	21.9	22.4
4-6 million yen	%	24.9	24.7	27.7
6-8 million yen	%	14.5	16.0	16.9
8-10 million yen	%	10.3	8.9	10.8
10-15 million yen	%	7.0	6.5	7.6
15-20 million yen	%	2.0	0.8	1.7
Over 20 million yen	%	1.3	1.2	1.4
Average * National average All households: 5.63‡ Workers' households: 6.48‡	million Yen	6.0	5.9	6.0

** Ref: 2000 Population Census of Japan, † Ref: 2004 Comprehensive Survey of Living Conditions of the People on Health and Welfare, ‡ "Workers' household" means the household whose head is a worker. Ref: 2004 Family Income and Expenditure Survey

Sample Screening Protocols

The survey was designed to offer ample opportunities to check on each respondent's understanding of the survey and their willingness and ability to take the exercise seriously. Starting from a sample sizes of 710 for the private-goods survey and 493 for the public-goods survey, we eliminated 246 and 179 respondents, respectively, from the analysis for reasons detailed below (refer to Table 14 and Table 15 in the appendix for further details).

As noted, respondents were given a practice conjoint question with a dominated option and then given another if they chose that option. Over both surveys, around 6.5 percent of respondents got the first practice question wrong and 1 percent (of the total) got the second question wrong. The latter were dropped. Another set of questions asked respondents for their reasons for choosing a particular option. In particular, if respondents chose the status quo for all six questions and their reason for those choices indicated they didn't take the survey seriously, they were dropped (75 in all). In addition, for the public-goods version, respondents were dropped if their reason for voting for the status quo had to do with paying taxes per se (44). In total, 10 percent were dropped for these reasons. Another set of questions was asked of everyone else about the reasons for their choices. In general, 75–85 percent of the sample had "good" reasons. Those that did not were dropped. We also dropped respondents using other debriefing questions. Those who did not assume the effects of programs would be in reality as stated and those who did not assume that they actually paid for the programs were dropped. As a result, we used about two-thirds of the sample (64–65 percent).

Scenario Acceptance

For the private-goods survey, about 80 percent of respondents in the cleaned sample were able to assume that the risks of the diseases examined in the survey applied to them; 44 percent were worried about the product or service they would buy and 34 percent said it influenced their WTP. Interestingly, the influence on WTP is statistically positive. This means that those who worried tended to pay more for the product or service, implying that the more seriously they considered purchasing the product or service, the more seriously they examined the possible quality of it. This is confirmed by our finding that only 25–34 percent of those who rejected the scenario worried about the product or service, and those who chose the status quo in all choice questions tended to worry less about the product (32 percent versus 51 percent).

A total of 90 percent or more answered “yes” to debriefing questions asking about their acceptance of various facets of the scenario. When asked which attributes most influenced their answers, the responses showed that all attributes had close to equal importance on average, with cost most important and latency second most. As expected, those who tended to choose a program over the status quo also tended to place a higher score on each attribute. The correlations with choice behavior are largest for lung cancer and cost.

For the public-goods survey, respondents also were asked a series of questions about acceptance of the scenarios. Between 85 percent and 90 percent accepted the scenarios. The results for importance of attributes were quite similar to those for the private goods, with cost, cessation lag, and lung cancer being slightly more important than other attributes. Respondents were asked a question about whether their bids were for altruistic motives. On average, the order of importance was other family members, then “yourself” (the respondent), and then nonfamily members in the community. Interestingly, the distribution of scores is very different between respondents with and without children (Table 5). The respondents with children allocated 4.4 points to “other family members,” while respondents without children allocated 3.0 points to “other family members”. This implies, not surprisingly, that within-family altruism is stronger when the respondent has children. A total of 49 percent were worried about the product or service they would buy and 39 percent said it influenced their WTP, but we find no statistically significant influence on WTP. Trust in the government to implement the public goods program was fairly low, with an average score of 2.5 (out of 5). However, this did not influence scenario acceptance; the score of trust in government is not different between those who accepted and rejected the scenario. The effect of trust in government is significant on WTP for risk reduction of pollen allergy and chronic bronchitis according to our multinomial logit analysis with cross terms for illness coefficients and score of government trust. We find the more respondents trust in government, the more they pay for risk reduction.

Table 5. Whose Chances of Diseases Did You Take into Consideration Most?

(Public goods context, cleaned sample)			
You have 10 points. Distribute the points among the following three groups according to their importance in your choice:	All respondents (N=312)	With children (N=198)	Without children (N=114)
Reduce your own chances of diseases	3.40	3.18	3.76
Reduce your other family members' chances of diseases	3.89	4.37	3.04
Reduce other persons' chances of diseases	2.72	2.44	3.20

Analysis

Analysis Method

In the method applied in this choice experiment, partial utilities are estimated using a multinomial logit model (conditional logit model). Then, by introducing cross- terms of age group dummies and types of goods offered (private goods or public goods) into the multinomial logit model, we examine the effects of these elements on the partial value. Finally, assuming a probability distribution for attributes coefficients, mixed logit models are applied to examine the coefficients' dispersion and effects related to respondents' characteristics.

For the multinomial logit model, a random utility model is assumed to express overall utility Uj when profile j is selected

$$U_j = V_j + e_j = \beta \cdot x_j + e_j \qquad (j = 1, 2, ..., J)$$

V_j shows observable part of utility, e_j non-observable part, x_j property vector of profile j, β parameter vector assumed.

Here, assuming the error term follows a Gumbel distribution (Type 1 extreme-value distribution), probability P_j to select profile j can be shown as follows:

$$P_j = \frac{\exp(V_j)}{\sum_k \exp(V_k)}$$

Here, k represents number of profiles presented at once. The scale parameter is standardized as 1. The parameter of partial value β is assumed to maximize the log likelihood by means of the maximum likelihood method.

For the mixed logit model, based on an assumption that the value of partial value β parameter would show a random distribution depending on individuals and options, the variance of the observable part and the nonobservable error influenced by individual attributes are estimated by using simulation.

Utility Function

In this study, the cessation lag—the period of time from implementation of the program until the program's effects appear— is given explicit treatment as an attribute of a program. However, this attribute is not valued for its own sake as a separate argument in the utility function but is assumed to affect overall utility through the timing of health risk reductions, as expressed in the rate of time preference. These rates are endogenous to the model.

At the same time, the cost of obtaining these risk reductions, whenever they occur, is paid every year over 10 years. We cannot estimate discount rates on these costs from the data because payments start at the first year in all choice questions.

Utility (U) in the choice experiment in this study is expressed in the following equation, which has a discounting calculation[8] for the illness risk-reduction terms. The discount effects are subject to the cessation lag.

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[8] We also tried another discounting calculation below consisting of two parts. The first part discounts the effects subject to the cessation lag, while the second part discounts effects for 10 years once they start after the cessation lag. Then, we calculated VSC in the same way. These calculations reflect real effects of scenarios we offered in the choice experiments. We obtained the exact same VSC from either discounting calculation.

$$\text{where, } PL(\text{Discounted}) = PL/10 * \frac{1}{(1+RTP)^{CL}} * (1 - \frac{1}{(1+RTP)^{10}}) * (1 - \frac{1}{1+RTP})^{-1}$$

$$VSC_{disease} = -\frac{\beta_{disease}}{\beta_{\cos t} * \Delta Risk} * 1/10 * \frac{1}{(1+RTP)^{CL}} * (1 - \frac{1}{(1+RTP)^{10}}) * (1 - \frac{1}{1+RTP})^{-1}$$

$U = ASC + \beta_{cost} * Cost$ (10-year total) $+ \beta_{PL} * PL$ (Discounted) $+ \beta_{CB} * CB$ (Discounted) $+ \beta_{LC} * LC$ (Discounted) (Equation 1)

where $PL(\text{Discounted}) = PL * \frac{1}{(1+RTP)^{CL}}$

as with *CB* (Discounted), *LC* (Discounted)

ASC: alternative specific constant

PL: pollen allergy, *CB*: chronic bronchitis, *LC*: lung cancer

CL: cessation lag, *RTP*: rate of time preference

Results

Analysis Using Multinomial Logit Model

The basic results of the conjoint surveys are summarized in Table 6, which provides the regression results for each of the four survey treatments and the implied VSC estimates for the three illnesses "attributes" based on the following equation. The VSCs are estimated separately for cessation lags of 0, 2, 5, and 10 years (as in the choice experiment).

$$VSC_{disease} = -\frac{\beta_{disease}}{\beta_{cost} * \Delta Risk} \quad \text{(Equation 2)}$$

where $VSC_{disease}$: value of a statistical case for disease

disease: pollen allergy, chronic bronchitis or lung cancer

ΔRisk: unit of risk reduction offered in the choice experiment =1/10000

CL: cessation lag, *RTP*: rate of time preference

Table 6. Estimation of Parameter, Rate of Time Preference, and VSC

		Coefficient	St. Error	P-value		VSC (million yen) by cessation lag				
						0 years[1]		2 years	5 years	10 years
Private goods context (Respondents 40s or younger) N=228 RTP: 9.2%	ASC	5.93E-01	1.05E-01	0.00	**	-		-	-	-
	Cost	-2.00E-03	1.81E-04	0.00	**	-		-	-	-
	PA	1.73E-02	3.99E-03	0.00	**	8.7	[5.1 to 13.2]	7.3	5.6	3.6
	CB	2.78E-02	2.69E-02	0.30						
	LC	1.00E+00	2.01E-01	0.00	**	500.6	[304.9 to 703.7]	419.5	321.9	207.0
	1+RTP	1.09E+00	2.91E-02	0.00	**	-		-	-	-
Private goods context (Respondents 50 or older) N=236 RTP: 31%	ASC	6.55E-01	9.40E-02	0.00	**	-		-	-	-
	Cost	-1.67E-03	1.80E-04	0.00	**	-		-	-	-
	PA	1.45E-02	4.59E-03	0.00	**	8.7	[3.1 to 14.3]	5.1	2.3	0.6
	CB	3.55E-02	3.07E-02	0.25						
	LC	6.23E-01	2.26E-01	0.01	**	373.2	[112.9 to 619.3]	218.9	98.3	25.9
	1+RTP	1.31E+00	1.50E-01	0.00	**	-		-	-	-
Private goods context (All respondents) N=464 RTP: 17.4%	ASC	6.05E-01	7.26E-02	0.00	**	-		-	-	-
	Cost	-1.83E-03	1.27E-04	0.00	**	-		-	-	-
	PA	1.49E-02	3.02E-03	0.00	**	8.1	[4.8 to 11.5]	5.9	3.6	1.6
	CB	3.68E-02	2.05E-02	0.07	*	20.1	[-1.9 to 40.9]	14.6	9.0	4.0
	LC	8.02E-01	1.51E-01	0.00	**	437.7	[274.9 to 595.2]	317.7	196.4	88.1
	1+RTP	1.17E+00	4.66E-02	0.00	**	-		-	-	-
Public goods context (All respondents) N=314 RTP: 1.3%	ASC	-4.21E-02	8.82E-02	0.63		-		-	-	-
	Cost	-2.45E-03	1.37E-04	0.00	**	-		-	-	-
	PA	1.81E-02	2.95E-03	0.00	**	7.4	[5 to 9.8]	7.2	6.9	6.5
	CB	6.58E-02	1.97E-02	0.00	**	26.9	[11 to 42.3]	26.2	25.2	23.7
	LC	7.25E-01	1.54E-01	0.00	**	295.9	[169.9 to 404.5]	288.6	277.9	261.0
	1+RTP	1.01E+00	1.35E-02	0.00	**	-		-	-	-

PA=Pollen Allergy; CB=Chronic Bronchitis; LC=Lung Cancer; RTP=rate of time preference; N=Number of valid responses

** P-value<5%; * P-value<10%

[1] 95% confidence intervals of VSCs are placed in squared parenthesis. We calculated them by Monte Carlo simulation based on the estimated parameters and the variance-covariance matrix of the estimated parameters, drawing samples of 1,000 observations.

Note: Coefficient for Cost expresses the value on paying 1,000 yen.

Referring first to the private-goods context for all respondents, we can see that all attributes, including the alternative specific constant (ASC) and the cessation lag, are significant at the 5 percent level, except chronic bronchitis, which is significant at the 10 percent level. The negative sign on cost and the positive signs on the illnesses are as expected, as utility should increase for larger risk reductions and decrease for larger costs of obtaining them. The positive sign on ASC implies that there is a bias against purchasing the product, irrespective of its attributes. The rate of time preference is estimated at 17 percent—certainly a high rate for even a private good, but not out of line with some estimates in Tsuge et al. (2005).

The coefficients on the illnesses can be used to derive VSC estimates. Our procedure for a private good is to divide the coefficient (the monetary representation of marginal utility) by the coefficient on cost times the risk reduction. This leads to VSCs of 15 million yen for a lifelong case of pollen allergy, 37 million yen for a case of chronic bronchitis, and 812 million yen for a lung cancer case.

Moving to the public-goods results, we see that the ASC is not significant (i.e., there is no bias toward or against the status quo) but all other attributes are significant, and the rate of time preference is, as expected, far lower than for a private good: 1.3 percent.[9] The VSC for public goods is calculated assuming that all 10,000 persons in the respondent's community pay the assessed tax. Then, as before, the VSC is the coefficient on the disease attribute divided by the cost coefficient multiplied by 10,000. With the rate of time preference 1.3 percent, VSCs are 7.8 million yen, 28.4 million yen, and 313 million yen for pollen allergy, chronic bronchitis and cancer, respectively—the same ranking as the VSCs for the private good, although using a very different discount rate in the calculations.

Because we had separate private-good survey treatments applicable to adults under 50 and 50 or over (with different baseline risks), we can examine how the VSCs vary over

[9] The difference in the rate of time preferences between the private-goods scenario and the public-goods scenario is attributed to the benefit of a public good, including altruistic benefits based on paternalistic altruism, while that of the private goods is self-concerned benefit. Note that the private-goods scenario provides respondents with no specific information on the provider of goods that are supposed to reduce illness risk. In the public-goods scenario, respondents are told that the government is considering implementing a program to control air pollution.

these two groups. Those under 50 have VSCs of 12 million yen for pollen allergy and 721 million yen for lung cancer, while the coefficient for chronic bronchitis was not significant. For respondents 50 and over, the VSCs are larger: 22 million yen for pollen allergy and 939 million yen for lung cancer. Rates of time preference are quite different across these two groups and are far lower for the younger group (9.2 percent versus 31 percent).

The magnitude of the calculated VSCs is, of course, heavily influenced by the rates of time preference. For a contrast, we now apply objective discount rates traditionally used in cost–benefit analysis instead of the estimates of the rate of time preference. In this case (Table 7), the VSCs change a great deal, especially in the private-goods context. Over discount rates from 0 percent to 7 percent, VSCs for the public goods generally are larger than those for the private goods for a common discount rate, except for lung cancer at a 7 percent discount rate. VSCs for lung cancer in the private-goods context are particularly sensitive to discounting. Note the estimated VSC for lung cancer is higher than previously estimated VSLs in Japan: 103 to 344 million yen from Itaoka et al. (2007) and 350 million yen from Tsuge et al. (2005).

Table 7. Comparison Of Calculated VSCs with Exogenous Discount Rate Applied to the Payment and Benefits (risk reduction of diseases)

Discount rate	VSC of zero cessation lag (million yen)					
	Private goods context			Public goods context		
	Pollen allergy	Chronic bronchitis	Lung cancer	Pollen allergy	Chronic bronchitis	Lung cancer
0%	4.2 [1.7 to 6.8]	--[1]	206.0 [77.1 to 333.7]	6.9 [4.9 to 9.0]	25.6 [9.8 to 39.5]	272.4 [165.4 to 381.2]
3%	5.6 [3.1 to 8.1]	8.5[2] [-12.0 to 26.3]	291.9 [152.8 to 420.6]	7.9 [5.9 to 10.1]	27.4 [11.3 to 42.1]	319.0 [205.6 to 438.2]
7%	7.0 [4.2 to 9.9]	17.7 [-1.7 to 34.7]	376.1 [225.8 to 522.5]	8.7 [6.2 to 11.4]	24.5 [8.1 to 40.3]	326.7 [189.4 to 464.6]

[1]The coefficient of chronic bronchitis with a 0% discount rate is not statistically significant at the 10% level and has negative value.

[2]The coefficient of chronic bronchitis with a 3% discount rate is not statistically significant at the 10% level but has positive value.

Note: 95% confidence intervals of VSCs are placed in squared parenthesis. We calculated them by Monte Carlo simulation based on the estimated parameters and the variance-covariance matrix of the estimated parameters, drawing samples of 1,000 observations.

Next, we pooled the sample and created age-group interaction terms to test whether age effects are statistically significant across the different illnesses. Note that the age 40s or younger group was presented with lower baseline risks for chronic bronchitis and lung cancer compared to the other age group (as shown in Table 2). Therefore, we will observe age effects confounded with baseline effects. We used the following equation 3 as the utility function:

$$U = ASC + {}_{cost}*\text{Cost (10-year total)} + {}_{PL}*\text{PL (Discounted)} + {}_{CB}*\text{CB (Discounted)} + {}_{LC}*\text{LC (Discounted)} + {}_{PL\_Ydummy}*\text{PL (Discounted)}*\text{Ydummy} + {}_{CB\_Ydummy}*\text{CB (Discounted)}*\text{Ydummy} + {}_{LC\_Ydummy}*\text{LC (Discounted)}*\text{Ydummy}$$

(Equation 3)

where $\text{PL(Discounted)} = \text{PL}*\frac{1}{(1+RTP)^{CL}}$

(as with CB (Discounted), LC (Discounted))

ASC: alternative specific constant

PL: pollen allergy, CB: chronic bronchitis, LC: lung cancer

CL: cessation lag, RTP: rate of time preference

Ydummy: dummy to respondents of age 40s or younger (respondent of 40s or younger: 1, that of 50s or older:0)

The results (shown in Table 8) are, first, that the rate of time preference is 14 percent and the VSCs are 10 million yen for pollen allergy, 41 million yen for chronic bronchitis, and 491 million yen for lung cancer. Of the three kinds of illnesses, only the age-lung cancer interaction term is significant and is 97.5 percent of the coefficient for lung cancer. This means the WTP for risk reduction of lung cancer of those 49 or younger is about two times higher than that of respondents 50 and older.

Table 8. Effects of Respondents' Age in Private-Goods Context (N=464)

	Coefficient	St. Error	P-value		VSC of zero cessation lag (million yen)	VSC ratio of 40s or younger
ASC	6.27E-01	7.30E-02	0.000	**	-	
Cost	-1.85E-02	1.28E-03	0.000	**	-	
Pollen Allergy	1.09E+00	3.93E-01	0.005	**	5.9	
Chronic Bronchitis	4.53E+00	2.64E+00	0.086	*	24.5	
Lung Cancer	5.39E+01	1.98E+01	0.006	**	291.0	
PA*Dummy for 40s or younger	7.27E-01	5.38E-01	0.177		-	-
CB*Dummy for 40s or younger	-1.31E+00	3.46E+00	0.706		-	-
LC*Dummy for 40s or younger	5.25E+01	2.60E+01	0.043	**	-	1.98
1+RTP	1.14E+00	3.52E-02	0.000		-	

** P-value<5% *P-value<10%

Note: Coefficient for Cost expresses the value on paying 10,000 yen.

Next, we pool the data from both surveys and add interaction terms for the context of the illness reduction (private or public) by type of illness to test whether WTP for the private-goods context for the illness reduction is significantly different than that for the same illness in the public-goods context. By pooling the data and not using an interaction term for the rate of time preference, we force the rate of time preference to be the same for both contexts. The results are as shown in Table 9. We use equation 4 as the utility function.

$U = ASC + {}_{cost}$ *Cost (10-year total) + ${}_{PL}$*PL (Discounted) + ${}_{CB}$*CB (Discounted) + ${}_{LC}$*LC (Discounted) + ${}_{PL\_Mdummy}$ *PL (Discounted)*Mdummy + ${}_{CB\_Mdummy}$ *CB (Discounted)*Mdummy + ${}_{LC\_Mdummy}$ *LC (Discounted)*Mdummy

(Equation 4)

where PL(Discounted) = $PL^* \frac{1}{(1+RTP)^{CL}}$

(as with CB (Discounted), LC (Discounted))

ASC: alternative specific constant

PL: pollen allergy, CB: chronic bronchitis, LC: lung cancer

CL: cessation lag, RTP: rate of time preference

Mdummy: dummy to respondents of private goods context (respondents of private goods context: 1, respondents of public goods context:0)

As shown, the interaction terms are all significant and negative, meaning that the VSCs for private goods in zero cessation lag are all smaller than those for public goods. Specifically, the private VSC calculated using the estimated discount rate of 3 percent is 65.2 percent lower than the public VSC for pollen allergy, 99.3 percent for chronic bronchitis, and 62.6 percent for lung cancer. The very small private VSC for chronic bronchitis in the private-goods context accords with findings in focus groups, where respondents tended to disregard chronic bronchitis in this context.

Table 9. Pooled Results (N=778)

	Coefficient	St. Error	P-value		VSC of 0 cessation lag (million yen)	VSC ratio of private goods context
ASC	3.28E-01	5.64E-02	0.000	**	-	
Cost	-2.09E-02	9.32E-04	0.000	**	-	
Pollen Allergy	2.26E+00	2.89E-01	0.000	**	10.8 (Public)	
Chronic Bronchitis	8.60E+00	1.86E+00	0.000	**	41.1 (Public)	
Lung Cancer	9.77E+01	1.48E+01	0.000	**	466.3 (Public)	
PA*Dummy for Private goods context	-1.47E+00	3.47E-01	0.000	**	-	0.35
CB*Dummy for Private goods context	-8.54E+00	2.20E+00	0.000	**	-	0.01
LC*Dummy for Private goods context	-6.11E+01	1.71E+01	0.000	**	-	0.37
1+RTP	1.03E+00	1.12E-02	0.000	**	-	

RTP=rate of time preference; ** P-value<5%; * P-value<10%

Note: Coefficient for Cost expresses the value on paying 10,000 yen.

The foregoing pooled model also forced the ASC term to be the same for both contexts; however, the individual models indicated that the ASC was different across the contexts. Hence, Table 10 shows the results of adding a context interaction term to the regression in Table 9. We find that this change has a dramatic effect. The ASC interaction term is highly significant and positive, meaning that there is a bias toward the status quo in the private-goods context. Once this effect is accounted for, the public goods WTP premium for illnesses becomes insignificant. Note also that the rate of time preference is larger, at 6.7 percent.

The final model in this series is identical to Table 10, but adds an additional interaction term for the rate of time preference. As shown in Table 11, this term is highly significant and basically recovers the gap observed from the context-specific regressions (1.2 percent for the public-goods context and 14.8 percent for the private-goods context). But again, we find the interaction terms for the illness in the private-goods context are not significant. The most unbiased VSCs for the pooled sample can be calculated with this model. The estimated VSCs with zero cessation lag for pollen allergy, chronic bronchitis, and lung cancer are 8, 23, and 301 million yen, respectively.

We also are interested in the role of personal characteristics in explaining WTP. Still within the multinomial logit framework, we examined the effect of smoking status on WTP for each disease using interaction terms. For public goods (not shown), we find that smokers are willing to pay significantly less for reducing the incidence of pollen allergies in their communities but are willing to pay more to reduce the incidence of lung cancer.[10]

[10] The results for the private-goods context are difficult to interpret because of the different baselines received by smokers.

Table 10. Pooled Results with ASC Interaction (N=778)

	Coefficient	St. Error	P-value		VSC of 0 cessation lag (million yen)	VSC ratio of private goods context
ASC	-9.80E-02	8.62E-02	0.256		-	
ASC for private goods context	7.34E+01	1.12E+01	0.000	**	-	
Cost	-2.10E-02	9.31E-04	0.000	**	-	
Pollen Allergy	1.95E+00	3.18E-01	0.000	**	9.3	
Chronic Bronchitis	4.51E+00	2.11E+00	0.033	**	21.5	
Lung Cancer	6.83E+01	1.64E+01	0.000	**	325.7	
PA*Dummy for private goods context	-6.16E-01	4.04E-01	0.128		-	-
CB* Dummy for private goods context	-2.38E-01	2.70E+00	0.930		-	-
LC* Dummy for private goods context	5.96E+00	2.09E+01	0.775		-	-
1+RTP	1.07E+00	1.49E-02	0.000	**	-	

RTP=rate of time preference

**P-value<5%; *P-value<10%

Note: Coefficient for Cost expresses the value on paying 10,000 yen.

Table 11. Pooled Results with RTP Interaction (N=778)

	Coefficient	St. Error	P-value	VSC of 0 cessation lag (million yen)	VSC ratio of private goods context
ASC	-2.73E-02	8.81E-02	0.757	-	
ASC for private goods context	6.13E-01	1.15E-01	0.000 **	-	
Cost	-2.12E-02	9.31E-04	0.000 **	-	
Pollen Allergy	1.69E+00	2.93E-01	0.000 **	8.0 [5.1 to 10.7]	
Chronic Bronchitis	4.90E+00	1.89E+00	0.010 **	23.1 [6.1 to 40.5]	
Lung Cancer	6.39E+01	1.50E+01	0.000 **	301.3 [163.7 to 439.7]	
PA*Dummy for private goods context	-1.63E-01	4.15E-01	0.695	-	-
CB* Dummy for private goods context	-1.74E-01	2.68E+00	0.948	-	-
LC* Dummy for private goods context	2.34E+01	2.08E+01	0.261	-	-
1+RTP	1.01E+00	1.52E-02	0.000 **	-	
RTP* Dummy for private goods context	1.48E-01	4.15E-02	0.000 **	-	

RTP=rate of time preference

**P-value<5%; *P-value<10%

Note 1: Coefficient for Cost expresses the value on paying 10,000 yen.

Note 2: 95% confidence intervals of VSCs are placed in squared parenthesis. We calculated them by Monte Carlo simulation based on the estimated parameters and the variance-covariance matrix of the estimated parameters, drawing samples of 1,000 observations.

Analysis Using Mixed Logit

Lastly, we provide results using the mixed logit model (or the random parameter logit model), which loosens the IIA assumption to allow coefficient parameters of each attribute to have a distribution across individuals and to permit the analysis of how personal and other characteristics affect WTP. The results are shown in Table 12 and Table 13.

Table 12. Result of Mixed Logit in Private-Goods Context (analyzed with 17% rate of time preference)

		Model 1				Model 2				Model 3			
		Coefficient		Std. error	P-value	Coefficient		Std. error	P-value	Coefficient		Std. error	P-value
ASC	Average	8.28E-01	**	2.71E-01	0.00	1.08E-01 (Non random parameter)		8.76E-02	0.22	2.68E+00		3.03E+00	0.38
	Dummy for women									-1.61E-01		6.32E-01	0.80
	Age									3.25E-02	*	1.94E-02	0.09
	Dummy for child									-2.38E+00	**	7.32E-01	0.00
	Dummy for residing area									-1.00E+00		6.24E-01	0.11
	Years of education									-4.93E-02		2.23E-01	0.82
	Dummy for university									-6.00E-01		1.12E+00	0.59
	Annual income per person									-2.40E-03		3.19E-03	0.45
	Std. deviation	4.98E+00	**	3.58E-01	0.00					4.89E+00	**	3.90E-01	0.00
Cost		-2.93E-03	**	1.78E-04	0.00	-3.28E-03	**	2.31E-04	0.00	-3.03E-03	**	2.11E-04	0.00
PA	Average	2.89E+00	**	3.98E-01	0.00	1.79E+01	**	3.92E+00	0.00	-3.38E+00		2.80E+00	0.23
	Dummy for women					1.18E+00		1.49E+00	0.43	6.64E-01		9.45E-01	0.48
	Age					-9.81E-02	*	5.30E-02	0.06	3.41E-02		3.24E-02	0.29
	Dummy for child					1.56E+00		1.77E+00	0.38	-1.12E+00		1.16E+00	0.34
	Dummy for residing area					3.32E+00	**	1.40E+00	0.02	1.39E+00		9.00E-01	0.12
	Years of education					-1.11E+00	**	3.57E-01	0.00	4.49E-01	*	2.38E-01	0.06
	Dummy for university					5.21E+00	**	2.45E+00	0.03	-1.36E+00		1.40E+00	0.33
	Annual income per person					-3.24E-03		5.86E-03	0.58	-4.55E-03		3.70E-03	0.22
	Std. deviation	2.89E+00	**	3.98E-01	0.00	1.79E+01	**	3.92E+00	0.00	3.38E+00		2.80E+00	0.23
CB	Average	2.88E+00		2.51E+00	0.25	1.95E+01		1.36E+01	0.15	-6.54E+01	**	1.77E+01	0.00
	Dummy for women					-1.45E+00	**	4.22E-01	0.00	3.19E+00		7.41E+00	0.67
	Age					3.98E+01	**	1.54E+01	0.01	1.76E-01		2.52E-01	0.49
	Dummy for child					2.34E-01		1.27E+01	0.99	7.27E+00		8.95E+00	0.42
	Dummy for residing area					-2.06E+01	**	2.71E+00	0.00	-9.98E+00		7.05E+00	0.16
	Years of education					9.05E+01	**	2.24E+01	0.00	3.51E+00	**	1.41E+00	0.01
	Dummy for university					1.45E-01	**	5.41E-02	0.01	-2.15E+01	**	1.03E+01	0.04
	Annual income per person					1.95E+01		1.36E+01	0.15	7.94E-02	**	2.82E-02	0.00
	Std. deviation	2.88E+00		2.51E+00	0.25	2.26E+02	**	2.21E+01	0.00	6.54E+01	**	1.77E+01	0.00
LC	Average	1.64E+02	**	2.11E+01	0.00	1.58E+03	**	1.45E+02	0.00	4.18E+02	**	1.26E+02	0.00
	Dummy for women					4.73E+01		9.15E+01	0.61	-2.14E+01		5.22E+01	0.68
	Age					-1.31E+01	**	2.97E+00	0.00	-2.53E+00		1.80E+00	0.16
	Dummy for child					3.35E+02	**	1.13E+02	0.00	8.74E+01		6.49E+01	0.18
	Dummy for residing area					4.31E+01		9.03E+01	0.63	-5.55E+01		5.00E+01	0.27
	Years of education					-1.11E+02	**	1.71E+01	0.00	-1.54E+01		1.12E+01	0.17
	Dummy for university					5.45E+02	**	1.37E+02	0.00	9.97E+01		7.57E+01	0.19
	Annual income per person					3.54E-01		3.66E-01	0.33	1.24E-01		2.00E-01	0.53
	Std. deviation	1.64E+02	**	2.11E+01	0.00	1.58E+03	**	1.45E+02	0.00	4.18E+02		1.26E+02	0.00
Log likelihood		-1935.145				-2129.247				-1775.099			
McFadden Pseudo Rho-squared		0.367				0.240				0.366			
N		464				425				425			

Note 1) PA=Pollen Allergy, CB=Chronic Bronchitis, LC=Lung Cancer, Dummy for women (female=1), Dummy for child (With child=1), Dummy for residing area (Tokyo=1), Dummy for university (university)

Note 2) ASC is assumed to follow normal distribution unless otherwise noted. PA, CB and LC are assumed to follow triangular distribution (mean=standard deviation). Cost is treated as a non random parameter

Note 3) **: P-value<5%; *: P-value<10%

Note 4) Coefficient for Cost expresses the value on paying 1,000 yen.

Table 13. Results of Mixed Logit in Public-Goods Context (analyzed with 1.3% rate of time preference)

		Model 1				Model 2				Model 3			
		Coefficient		Std. error	P-value	Coefficient		Std. error	P-value	Coefficient		Std. error	P-value
ASC	Average	-9.87E-01	**	2.76E-01	0.00	-4.39E-01 (Non random parameter)	**	1.19E-01	0.00	1.36E+01	**	3.76E+00	0.00
	Dummy for women	-		-	-					-2.38E-01		6.65E-01	0.72
	Age	-		-	-					-5.93E-02	**	2.31E-02	0.01
	Dummy for child	-		-	-					4.89E-01		7.03E-01	0.49
	Dummy for residing area	-		-	-					-8.69E-01		6.78E-01	0.20
	Years of education	-		-	-					-8.76E-01	**	2.71E-01	0.00
	Dummy for university	-		-	-					2.41E+00	**	1.18E+00	0.04
	Annual income per household	-		-	-					-1.17E-03		8.47E-04	0.17
	Std. deviation	3.96E+00	**	3.22E-01	0.00					4.01E+00	**	3.63E-01	0.00
Cost		-3.55E-03	**	2.04E-04	0.00	-4.78E-03	**	2.98E-04	0.00	-4.21E-03	**	2.82E-04	0.00
PA	Average	2.99E-02	**	3.67E-03	0.00	1.89E-01	**	2.18E-02	0.00	1.04E-02		1.12E-02	0.35
	Dummy for women	-		-	-	1.45E-02		1.38E-02	0.29	-1.37E-03	**	3.40E-04	0.00
	Age	-		-	-	-1.82E-03	**	4.15E-04	0.00	4.23E-02	**	1.20E-02	0.00
	Dummy for child	-		-	-	4.63E-02	**	1.46E-02	0.00	1.97E-02	*	1.06E-02	0.06
	Dummy for residing area	-		-	-	3.23E-02	**	1.29E-02	0.01	-4.68E-03	**	1.71E-03	0.01
	Years of education	-		-	-	-1.12E-02	**	2.34E-03	0.00	3.65E-02	**	1.55E-02	0.02
	Dummy for university	-		-	-	7.00E-02	**	2.00E-02	0.00	-1.01E-05		1.38E-05	0.46
	Annual income per household	-		-	-	-2.50E-06		1.84E-05	0.89	1.04E-02		1.12E-02	0.35
	Std. deviation	2.99E-02	**	3.67E-03	0.00	1.89E-01	**	2.18E-02	0.00	1.07E-01	**	1.54E-02	0.00
CB	Average	9.34E-02	**	2.34E-02	0.00	1.08E+00	**	1.25E-01	0.00	4.20E-01	**	1.33E-01	0.00
	Dummy for women	-		-	-	2.34E-02		8.20E-02	0.78	2.24E-02		6.11E-02	0.71
	Age	-		-	-	-4.40E-03	*	2.42E-03	0.07	-3.76E-03	*	1.99E-03	0.06
	Dummy for child	-		-	-	1.07E-02		8.72E-02	0.90	-3.28E-03		6.62E-02	0.96
	Dummy for residing area	-		-	-	2.69E-02		7.73E-02	0.73	-3.42E-02		5.97E-02	0.57
	Years of education	-		-	-	-7.64E-02	**	1.36E-02	0.00	-1.66E-02		1.26E-02	0.19
	Dummy for university	-		-	-	2.74E-01	**	1.12E-01	0.01	-5.56E-03		8.39E-02	0.95
	Annual income per household	-		-	-	2.47E-04	**	1.05E-04	0.02	1.43E-04	*	7.88E-05	0.07
	Std. deviation	9.34E-02	**	2.34E-02	0.00	1.08E+00	**	1.25E-01	0.00	4.20E-01	**	1.33E-01	0.00
LC	Average	1.08E+00	**	1.84E-01	0.00	8.26E+00	**	8.63E-01	0.00	2.60E+00	**	1.15E+00	0.02
	Dummy for women	-		-	-	-8.78E-02		6.30E-01	0.89	-1.32E-01		4.62E-01	0.78
	Age	-		-	-	-2.06E-02		1.86E-02	0.27	4.40E-03		1.48E-02	0.77
	Dummy for child	-		-	-	-2.05E+00	**	6.72E-01	0.00	-1.86E+00	**	5.11E-01	0.00
	Dummy for residing area	-		-	-	-1.25E-01		5.86E-01	0.83	-8.66E-01	*	4.55E-01	0.06
	Years of education	-		-	-	-4.70E-01	**	9.78E-02	0.00	-3.16E-02		9.88E-02	0.75
	Dummy for university	-		-	-	1.84E+00	**	8.34E-01	0.03	9.31E-03		6.70E-01	0.99
	Annual income per household	-		-	-	1.83E-03	**	8.60E-04	0.03	1.06E-03	*	5.76E-04	0.07
	Std. deviation	1.08E+00	**	1.84E-01	0.00	8.26E+00	**	8.63E-01	0.00	2.60E+00	**	1.15E+00	0.02
Log likelihood		-1432.995				-1453.401				-1269.247			
McFadden Pseudo Rho-squared		0.308				0.234				0.331			
N		314				288				288			

Note 1) PA=Pollen Allergy, CB=Chronic Bronchitis, LC=Lung Cancer, Dummy for women (female=1), Dummy for child (With child=1), Dummy for residing area (Tokyo=1), Dummy for university (university)

Note 2) ASC is assumed to follow normal distribution unless otherwise noted. PA, CB and LC are assumed to follow triangular distribution (mean=standard deviation). Cost is treated as a non random parameter

Note 3) **: P-value<5%; *: P-value<10%

Note 4) Coefficient for Cost expresses the value on paying 1,000 yen.

The coefficients for the three kinds of illnesses are assumed to follow a triangular distribution where the coefficients always have a positive sign over the individuals in the sample and the coefficient for ASC is assumed to follow a normal distribution. In both tables, Model l is presented with only these random parameters and a non-random parameter (cost) and Model 2 and Model 3 have the random parameters expressed as conditional on seven personal characteristics of respondents: gender (female:1, male:0); age; child (have one or more children:1, have no child:0); area of residence (Tokyo:1, Osaka:0); years of education; whether graduated from a university (university graduate:1, other:0); and annual income (per household or per household member). Note in Model 2, ASC is assumed to be a non-random parameter to see the effects of the personal characteristics of respondents on the disease coefficients without such effects on ASC.

Table 12 shows the best-performing results for the private-goods context for Model 2, which uses income per household member. In the calculation, we assume a 17 percent discount rate (the implied rate of time preference from Table 6). There is a significant degree of unobserved heterogeneity as reflected in the significant standard deviations of the parameters of all three illnesses in either Model 1 or Model 2. ASC is significant in Model 1, as with conditional logit result (Table 6), but is not significant in Model 2, implying that respondents are neutral in choosing a product or service offered once their personal characteristics are captured.

The type of disease is significant in Model 1 and Model 2. Some attributes that affect WTP in Model 2 (generally significant at 0.1–5 percent level) are: 1) age for all diseases (the older, the less respondents are willing to pay); 2) whether the respondent resides in Tokyo or Osaka for pollen allergy (those in Tokyo are willing to pay more); 3) the respondent has children, for chronic bronchitis and lung cancer (those with children are willing to pay more); 4) years of education for all diseases (those who have more years of education are willing to pay less); 5) whether the respondent graduated from a university for all diseases (university graduates are willing to pay more); and 6) annual income per person for chronic bronchitis (those with children and who are more wealthy are willing to pay more).

Note as for 1, age effects might be confounded with baseline effects.

Table 13 shows the best-performing results for the public-goods context for Model 2, which uses annual household income. In the calculation, we use a 1.3 percent discount rate (the rate of time preference in Table 6). There is also a significant degree of unobserved heterogeneity as reflected in the significant standard deviations of the parameters of all three illnesses in either Model 1 or Model 2. ASC is significant; unlike with the conditional logit result where ASC is not significant (Table 6), ASC has a positive sign in Model 1 but a negative sign in Model 2, implying respondents' personal characteristics explain their disutility in choosing a program and they obtain utility from choosing a program once their personal characteristics are captured. This can be interpreted as a warm-glow effect, which is hidden in the conditional logit model due to heterogeneity of individuals.

The type of disease is significant in Model 1 and Model 2. In Model 2, some attributes that affect WTP (generally significant at 0.1–5 percent level) are: 1) age for pollen allergy and chronic bronchitis (the older the respondent, the less they are willing to pay); 2) whether the respondent resides in Tokyo or Osaka for pollen allergy (those in Tokyo are willing to pay more); 3) whether the respondent has children for pollen allergy and lung cancer (those with children are willing to pay more for pollen allergy but less for lung cancer); 4) years of education for all disease (those who have more years of education are willing to pay less); 5) whether the respondent has graduated a university for all disease (university graduates are willing to pay more); and 6) annual income per household for chronic bronchitis and lung cancer (those with children and who are more wealthy are willing to pay more).

Effects of 2, 4, and 5 are common to private-goods and public-goods contexts. Age affects for pollen allergy are clearly shown in a public-goods context (not confounded with baseline effects), implying that older people have less utility in reducing pollen allergy. Age effects for chronic bronchitis appear in the same way, but the effects are relatively weak (significant at 7 percent). The effects of having children in a public-goods context are different from those in the private-goods context. Having children is significant but has a negative sign for reducing risks of lung cancer in contrast to reducing risks of pollen allergy. This might be partially explained by respondents with children giving more consideration to "other family members" and placing more importance on reducing risks of pollen allergy compared to respondents who do not have children, as shown in the debriefing questions. In fact, parents see their children at high risk of suffering from pollen allergy but at quite low risk of suffering from lung cancer. Income effects for pollen allergy are common to both contexts, while we see an income effect for lung cancer only in the public-goods context.

Conclusion

We conducted a choice experiment presenting respondents with risk reductions for three types of illnesses related to air pollution—pollen allergy, chronic bronchitis, and lung cancer—splitting the sample to test the effects of a private-goods context and a public-goods context on the VSC of each illness type.

The estimated VSCs of these illnesses accorded with our expectation that pollen allergy would be valued less than chronic bronchitis, which would be valued less than lung cancer. However, the VSC for chronic bronchitis often was not estimated with much precision, particularly in the private-goods case, as we expected from focus group interactions. In terms of the private/public goods contexts, when exogenous rates of time preference/discount rates were applied to the estimation procedure, the VSC for a specific illness almost always was larger for the public-goods context. However, because estimated rates of time preference are far larger in the private-goods context (17 percent versus 1.3 percent), the benefits are lower, and, as they are the denominator in the VSC calculation, the VSCs for the private-goods context are larger. Concerning the value of future risk reductions, we find that the private VSCs for future risk reductions are smaller than those in the public-goods context

Indeed, these results are reinforced by results from a model pooling all respondents. While we at first find a WTP premium for the public-goods context, once we correct for a bias toward choosing the status quo in the private-goods context and take into account the differences in rates of time preference across contexts, this premium becomes insignificant. Based on the pooled sample in a model allowing for differential status quo bias across contexts and also allowing for differences in rates of time preference across contexts, the estimated VSCs with zero cessation lag and context adjusted are 8, 23, and 301 million yen for pollen allergy, chronic bronchitis, and lung cancer, respectively.

The story is further complicated once we add covariates to the private-goods model in a mixed logit framework. Respondents were found to be neutral in choosing a product or service offered once we allow coefficient parameters of each illness attribute to have a distribution across individuals, reflecting respondents' heterogeneous characteristics. Using the mixed logit model, we also find a bias of respondents toward choosing a program in the public-goods context.

One cautionary note is that there may have been differences in the credibility and understanding of these contexts that affect many aspects of the estimation. For instance, we find that there are lower levels of significance for coefficients of chronic bronchitis in the private-goods context. Further, in comparing responses to our various debriefing questions across contexts (where such questions were included to help measure credibility, at least qualitatively), we find that 44 percent of respondents in the private-goods context and 49 percent in the public-goods context "worried about" the product or program. We find no statistically significant effects on WTP for the public-goods context but positively significant effects (they paid more) for the private-goods context with the conditional logit analysis. Although this effect is interpreted as relating to the degree with which respondents took the survey seriously, this behavior could influence the credibility of WTP in the private-goods context, where the estimated coefficients tend to have a larger standard error than in the public-goods context.

In terms of the effects of covariates, the WTP for risk reduction is fairly similar across contexts. For private goods, the WTP to reduce the risk of lung cancer of those age 49 or younger is about two times higher than that of respondents age 50 and older. Smokers are willing to pay significantly less for reducing the incidence of pollen allergies in their communities but are willing to pay more to reduce the incidence of lung cancer.[11] Other attributes also were found to affect WTP.

[11] The results for the private-goods context are difficult to interpret because of the different baselines received by smokers.

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Appendix

Table 14. Sample Screening for Choice Experiment in Private-Goods Version (N=710)

	Number (persons)	Ratio (%)	Dropped from further analysis (indicated by X)
Responses to practice choice questions			
Respondents who chose apparently inferior product or service in first practice question	45	6.3%	
Respondents who chose apparently inferior product or service in second practice question	9	1.3%	X
Debriefing Questions			
Reasons for choice experiment question / Respondents who choose No product or service (Status quo)" in all questions			
Products or services are attractive, but too expensive.	48	6.8%	
All products or services have too little effects for the costs.	49	6.9%	
I couldn't assume the effects of products or services.	37	5.2%	X
I ' m satisfied with "status quo" and I don't need products or services.	176	24.8%	
I think other types of products or services are necessary	11	1.5%	X
Others	13	1.8%	
Reasons for choice experiment question / Respondents who choose one or more products or services in the questions			
I considered the effects of the products or services and decided to pay for those.	217	30.6%	
I didn't consider the effects of the products or services, but decided to pay for those.	15	2.1%	X
Others	6	0.8%	
Respondents who aren't faced with this question*	138	19.4%	
Did you answer questions assuming that products or services have effects on you?			
Yes	521	73.4%	
No	189	26.6%	X
Did you assume that you actually paid for the products or services when you answered?			
Yes	577	81.3%	
No	133	18.7%	X

* A part of the sample (19.4%) taken in the earlier stage of the survey period was not asked this question.

Table 15. Sample Screening for Choice Experiment in Public-Goods Version (N=493)

	Number (persons)	Ratio (%)	Dropped from further analysis (indicated by X)
Responses to practice choice questions			
Respondents who chose apparently inferior program in first question	33	6.7%	
Respondents who chose apparently inferior in second question	3	0.6%	X
Debriefing Questions			
Reasons for choice experiment question / Respondents who choose “No program (Status quo)” in all questions			
Programs are necessary, but too expensive.	59	12.0%	
All programs have too little effects for the tax increase to be worthwhile.	24	4.9%	
Programs are necessary, but I don’t like the idea of covering them with our taxes.	44	8.9%	X
I couldn’t assume the effects of programs.	16	3.2%	X
I’m satisfied with the “status quo” and I don’t need programs.	22	4.5%	
I think other types of programs are necessary.	11	2.2%	X
Others	8	1.6%	
Reasons for choice experiment question / Respondents who choose one or more programs in the questions			
I considered the effects of the products or services and decided to pay for those.	295	59.8%	
I didn’t consider the effects of the products or services, but decided to pay for those.	5	1.0%	X
Others	9	1.8%	
DQ(Public)3: Did you assume the effects of programs?			
Yes	378	76.7%	
No	113	22.9%	X
DQ(Public)4: Did you assume that you actually paid for the products or services when you answered?			
Yes	417	84.6%	
No	74	15.0%	X

Table 16. Descriptive Statistics on Debriefing Questions in Private-Goods Context (cleaned sample N=464)

	Number (persons)	Ratio (%)
Did you assume chances of diseases for 10 years as yours when you answered questions on products or services?		
Pollen allergy		
1. Yes	378	81.5%
2. No	86	18.5%
Chronic bronchitis		
1. Yes	366	78.9%
2. No	98	21.1%
Lung cancer		
1. Yes	368	79.3%
2. No	96	20.7%
Did you worry about side effects of using a product or service when you were making choices? *		
1. Yes	135	43.7%
2. No	174	56.3%
(to respondents who answered “Yes” in the previous question) Did that worry influence your choices? *		
1. Yes	104	33.7%
2. No	31	10.0%
Did you consider effects other than the effects of products or services when you answered?		
1. Yes	32	6.9%
2. No	432	93.1%
Did you think of specific products or services?		
1. Yes	57	12.3%
2. No	407	87.7%
How much did importance did you put on each attribute when you chose products or services? (1: I don’t put importance on it, 3: ?, 5: I put importance on it) *		
Cessation lag	3.7 (Mean)	-
Pollen allergy	3.3 (Mean)	-
Chronic bronchitis	3.3 (Mean)	-
Lung cancer	3.6 (Mean)	-
Cost	4.1 (Mean)	-

* A part of the sample (36.1%) taken in the earlier stage of the survey period was not asked this question.

Table 17. Descriptive Statistics on Debriefing Questions in Public-Goods Context (cleaned sample N=314)

	Number (persons)	Ratio (%)
Did you consider the effect of programs as the reduction of probability of diseases in your community?		
1. Yes	209	66.6 %
2. No	104	33.1 %
Whose chances of diseases did you take into consideration most? You have 10 points. Distribute the points among the following three groups according to their importance to your choice.		
Reduce your own chances of diseases	3.4 (Mean)	-
Reduce your nearest families' chances of diseases	3.9 (Mean)	-
Reduce other persons' chances of diseases	2.7 (Mean)	-
Did you assume new cases of 3 diseases for 10 years in a community of 10,000 as described in this questionnaire?		
1. Yes	282	89.8 %
2. No	31	9.9 %
Did you consider effects other than the effects of programs when you answered?		
1. Yes	48	15.3 %
2. No	266	84.7 %
How much importance did you put on each attribute when you chose programs? (1: I don't put importance on it, 3: ?, 5: I put importance on it) *		
Cessation lag	3.6 (Mean)	-
Pollen allergy	3.5 (Mean)	-
Chronic bronchitis	3.5 (Mean)	-
Lung cancer	3.5 (Mean)	-
Cost	4.4 (Mean)	-
Did you worry about side of effects of using a program when you were making choices? *		
1. Yes	82	48.5%
2. No	87	51.5%
(to respondents who answered "Yes" in the previous question) Did that worry influence your choices? *		
1. Yes	65	38.5%
2. No	17	10.1%
Do you usually trust on the government's policies? (1: I don't trust, 3: I somewhat trust, 5: I trust)		
	2.5 (Mean)	-

* A part of the sample (50.1%) taken in the earlier stage of the survey period was not asked this question.

Figure 1. Conjoint Screen Setup

<Private-goods scenario>

There are several kinds of products or services, by which the reductions of chances of 3 diseases are different. You of course can decline to have the product or the service.

Q: Which one of three options, “No product or service (Status quo)”, “Product or service 1”, or “Product or service 2” would you choose?

Chances of diseases for 10 years and cost necessary for product or service

		No product or service (Status quo)	Product or Service 9	Product or Service 10
Latency		-	5 years	0 year
Chances of diseases for 10 years	Pollen Allergy	10%	9.5% (0.5% reduction)	6% (4% reduction)
	Chronic Bronchitis	2.8%	2.5% (0.3% reduction)	2.8% (No change)
	Lung Cancer	0.8%	0.78% (0.02% reduction)	0.75% (0.05% reduction)
Annual cost necessary for product or service [Total cost for 10 years]		No cost [¥ 0]	¥ 2,400 [¥ 24,000]	¥ 84,000 [¥ 840,000]
YOUR ANSWER (Which one of the three options would you choose?)				

The government has been doing a lot to reduce air pollution and related health effects to humans already. A new program is being contemplated that will reduce concentration of air pollutants. However, the cost will need to be borne by the government and industry, and eventually be incurred by household as increases of tax payment. If this program were put in place, the community would benefit by lowering new cases of these 3 diseases, pollen allergy, chronic bronchitis, and lung cancer, that are partially caused by air pollutants, although the benefits would take a few years before they can be fully realized.

Q: Which one of three options, "No program (Status quo)", "Program 1", or "Program 2" would you choose?

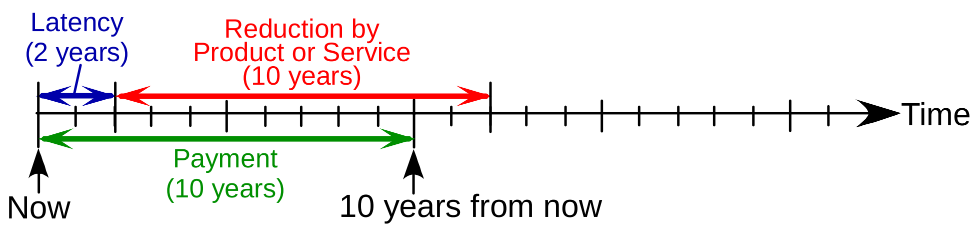
New cases of diseases for 10 years in a community of 10,000 and tax for programs

		No program (Status quo)	Program 9	Program 10
Latency		-	5 years	0 year
New cases of diseases for 10 years in a community of 10,000	Pollen Allergy	1000 persons	950 persons (50-person reduction)	600 persons (400-person reduction)
	Chronic Bronchitis	200 persons	170 persons (30-person reduction)	200 persons (No change)
	Lung Cancer	40 persons	38 persons (2-person reduction)	35 persons (5-person reduction)
More tax for program per year, household [Total cost for 10 years]		No cost [¥ 0]	¥ 4,000 [¥ 40,000]	¥ 96,000 [¥ 960,000]
YOUR ANSWER (Which one of the three options would you choose?)				

Figure 2. The Relation between Cessation Lag (Latency) and the Time Phasing of Cost (or Tax) Payment and Improvements Used in the Questionnaire

<Private-goods scenario>

Example of 2-year latency



Example of 10-year latency

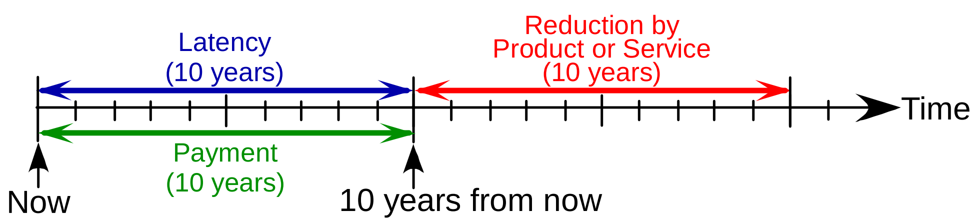
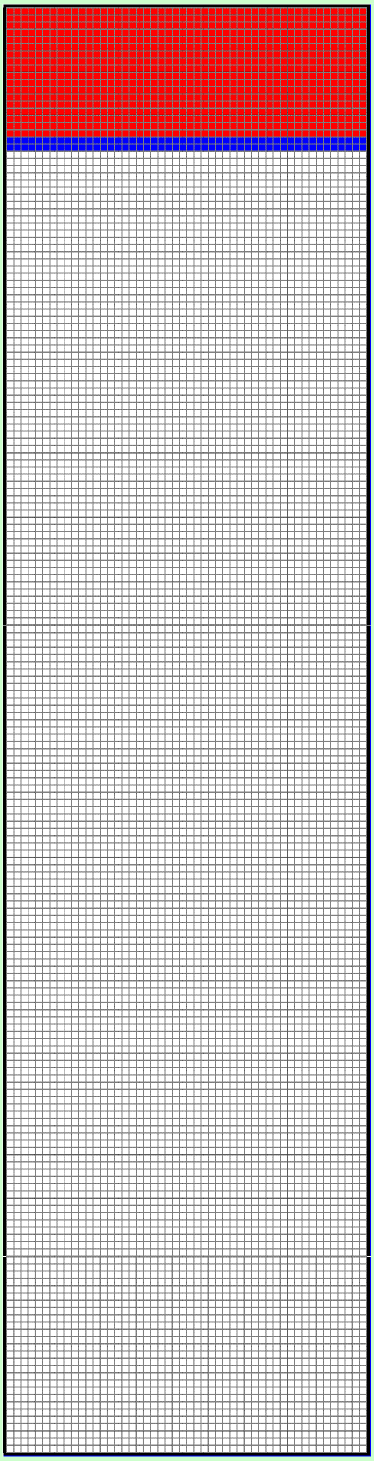
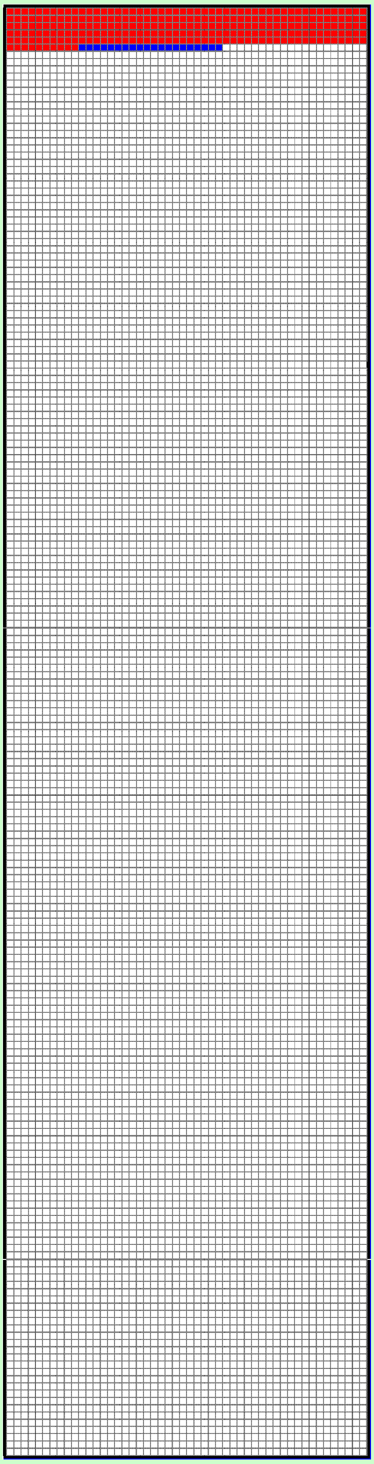


Figure 3. Graphs That Show Examples of Effects to Respondents in the Questionnaire

<Private-goods scenario>

Example of effects of product or service (Reduction chances of diseases for 10 years)
[Square □ shows 0.01%. Total number of square □ is 10,000.]

	Pollen Allergy	Chronic Bronchitis	Lung cancer
Status quo	10%	2.8%	0.8%
Product or service 1	9% [Area of ■] (1% reduction) [Area of ■] 	2.6% [Area of ■] (0.2% reduction) [Area of ■] 	0.75% [Area of ■] (0.05% reduction) [Area of ■]