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The Impacts of Recent Smoking Control Policies on Individual Smoking Choice

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[Abstract]

In recent years, a series of smoking control policies have been enforced in Japan. Using micro-data from nationwide surveys, this paper comprehensively examines the impact of recent smoking control policies on the individual's smoking decision, in particular, increases in cigarette taxes, the enforcement of the Health Promotion Law (HPL) (the first legislation in Japan that prohibits people from smoking in public spaces), and the enlargement of the written health warnings about smoking on cigarette packages. Empirical results show that females are more responsive to smoking control policies than males. In particular, increases in cigarette tax and the enlargement of the health warnings significantly reduce the probability of smoking, while the implementation of the HPL has no remarkable effect. It is also found that older, more highly educated, or married individuals have a lower probability of smoking. In addition, individuals who drink habitually have a higher probability of smoking than those who do not drink. Moreover, it is also found that the effects of the increase in cigarette tax and warnings decrease with age, and that the HPL has a large impact of reducing manual workers' probability of smoking.

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Keywords: smoking decision, cigarette tax, the Health Promotion Law, health warning on cigarette packages

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1. Introduction

In today's society, it is well known that smoking causes serious health problems not only for smokers, but also for nonsmokers through second-hand smoke. In order to reduce damage to health from smoking, The Framework Convention on Tobacco Control was ratified at the World Health Organization (WHO) in 2003, and a variety of smoking control policies have been implemented in many developed countries. For example, various smoking restrictions are enforced in many European countries (the WHO Regional Office for Europe, 2007) and individual states in the U.S. have imposed several smoking restrictions.

In contrast, in Japan, the government has only recently begun to enforce several smoking control policies in order to reduce both medical expenditure due to smoking related diseases and the smoking rate in line with other developed countries through the "National Health Promotion in the 21st century" initiative (Health Japan 21). According to Figure 1, although smoking rates of Japanese females remains at lower levels than the average of the OECD countries, those of males remain at a higher level than the OECD average. However, since the males' smoking rates have decreased sharply in recent years, it seems that the recent smoking control policies have had some effect.

<Figure 1>

In Japan, several researchers also have empirically analyzed the demand for cigarettes and smoking choices by using short-term micro-data[1]. More specifically, both the

[1] There are numerous studies that examine the effects of an increase in cigarette taxes as

demand for cigarettes and the probability of smoking are significantly reduced by an increase in cigarette prices (Sato and Ohkusa, 2002; Kadota et al., 2005), by the high relative risk-aversion coefficients (Ii and Ohkusa, 2002; Ida and Goto, 2009a, 2009b) and by the implementation of smoking regulations at home, in the office, and public spaces (Sato and Ohkusa, 2002; Ogura et al., 2005; Ishii and Kawai, 2006; Morozumi and Ii, 2006).

This paper is the first study that comprehensively examines the impacts of several smoking control policies recently implemented in Japan on individual smoking choice. In addition, I empirically analyze the effects of those policies on three age-groups and with three types of employment status to examine them in more detail. As for the empirical analyses, this paper particularly reconsiders the following econometric problems that were raised by previous Japanese empirical studies: First, this study uses the multi-year dataset, while previous studies have used cross sectional datasets. Since the Japanese smoking control policies are uniformly enforced nationwide, it is difficult to distinguish between the effects of those policies and the yearly effects by using a cross sectional dataset. Therefore, using the multi-year dataset has the advantage that we can examine the impact of several smoking control policies on smoking behavior in more comprehensive and detailed manner. Second, previous Japanese studies that analyze the effects of smoking bans on smoking behavior have not discussed their endogeneity in enough depth. As Evans, Farrelly, and Montgomery (1999) discuss, however, smoking restrictions in public places will generate a potential for self-selection bias. Therefore, it is necessary to show that smoking bans are

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well as of several smoking control policies on smoking behavior. Chaloupka and Warner (2000) comprehensively summarize these studies and show that the price elasticity of cigarette consumption is approximately -0.4 and that of the probability of smoking participation is approximately -0.1.

exogenous in order to correctly estimate their true effect. In this study, the enforcement of the Health Promotion Law in May 2003 by the government issued as a proxy for a smoking ban in public places to overcome this endogenous problem.

This paper is organized as follows: Section 2 briefly overviews the recent smoking control policies in Japan. Section 3 presents the econometric models. Section 4 describes the dataset. Section 5 presents the empirical results. Section 6 conducts further empirical analyses on three age-groups and with three types of employment formats. Section 7 concludes the paper.

2. Brief Overviews of Recent Smoking Control Policies in Japan

Table 1 summarizes the smoking control policies implemented in this century; increase in cigarette tax, the enforcement of the Health Promotion Law (HPL), restrictions on cigarette companies, and healthcare insurance reform in 2006.

<Table 1>

In this century, the Japanese government increased the cigarette tax per cigarette by 1 yen in July 2003 and in July 2006, and by 3.5 yen in October 2010. Additionally, the Japan Tobacco, Inc. (JT) raised cigarette prices per cigarette by 0.5 yen to cover the cost of introducing new cigarette vending machines that check that buyers are adults through the use of IC cards (*Taspo*) in 2006 (the JT, 2006) and by 1.5 yen to compensate for the expected lower revenues due to the substantial price increase in 2010 (the JT, 2010).

Nevertheless, the Japanese cigarette prices are still much lower than in most other OECD countries. Specifically, the WHO (2009) reports that the cigarette price of the top-selling brand in Japan is only approximately 63 percent of that of the OECD average (not including Japan).

The Health Promotion Law (HPL) was enforced in May 2003 in order to establish the basic frameworks for improving the nutritional status and the health of Japanese people. In particular, article 25 of the HPL is the first provision in Japan that has stipulations for preventing second-hand smoke inhalation by the managers of public spaces, such as schools, gymnasiums, restaurants, hospitals, theaters, assembly halls, exhibition halls, department stores, business offices, and government and other public offices. However, it has been pointed out that the HPL has had little effect because there are no penalties for disobedience to the above rule. In contrast, several local governments and railroad companies have voluntarily taken measures for preventing second-hand smoke inhalation, and some of them actually levy fines for smoking in public spaces.

In July 2005, the Japanese central government required cigarette companies to enlarge the warning labels printed on both sides of package in compliance with the WHO Framework Convention on Tobacco Control. More specifically, these companies are obliged to print warnings, such as the health risks due to smoking, the risk of nicotine addiction, and premature birth.

Finally, under health insurance reform in 2006, the treatment for quitting smoking and prescriptions for nicotine patches were additionally covered by the public health insurance. More specifically, this applies to individuals who satisfy the following requirements: (1) A patient who is diagnosed with nicotine addiction through the Tobacco

Dependence Test (TDS, Kawakami et al., 1991), (2) a patient whose Brinkman index [2] exceeds 200, and (3) a patient who wants to quit smoking immediately and agrees to participate in the smoking cessation program created by the Japanese Circulation Society, the Japan Lung Cancer Society, and the Japanese Cancer Association.

This paper considers in particular the influences of an increase in cigarette tax, the enforcement of the HPL, and the enlargement of the written health warnings on packages. In other words, I do not examine the effect of the 2006 health insurance reform due to the data limitations.

3. Econometric Model

3.1 Basic model

Based on the random utility model, this study applies two specifications in order to examine the effects of several smoking control policies on individual smoking choice. The first specification is a simple binary choice model:

$$Smoking_{it}^{*} = \alpha_0 + \alpha_1 Cigtax_t + \alpha_2 HPL_t + \alpha_3 Warning_t + \alpha_4 Attribute_{it} + \alpha_5 Season_t + \alpha_6 Year_t + \varepsilon_{it}, \quad (1)$$

$$Smoking_{it} = \begin{cases} 1 & if \quad Smoking_{it}^{*} > 0 \\ 0 & otherwise \end{cases}.$$

[2] The Brinkman index is defined as the product of the number of cigarettes smoked per day and number of years of smoking. In particular, it is pointed out that the second requirement inhibits younger smokers from smoking because individual's number of years of smoking is used for the calculation of the Brinkman index.

Smoking is an indicator of whether individual *i* is a current smoker. *Cigtax*, *HPL*, and *Warning* are the proxies of smoking control policies: *Cigtax* is the amount of cigarette tax per pack in year *t* adjusted to 2005 prices; *HPL* is an indicator of whether the observations take place after the year 2003; and *Warning* is an indicator of whether the observations take place after the year 2005. α_1, α_2, and α_3 are expected to be statistically significant and negative if these policies have negative impacts on the probability of smoking. Note that the price level for cigarettes can be also used as proxy for a price factor. As shown in section 2, however, the JT additionally increased the cigarette price by 0.5 yen in 2006 to cover the cost of introducing new cigarette vending machines. This means that cigarette companies engage with increasing price. Thus, using the cigarette price level makes estimates inconsistent due to simultaneous bias. Therefore, this paper uses cigarette tax per pack, as that can be changed only by the central government of Japan. On the other hand, as Evans, Farrelly, and Montgomery (1999) point out that smoking restrictions in public places are sometimes endogenous because they generate a potential for self-selection bias; (1) firms and areas with many nonsmokers tend to implement smoking bans; (2) nonsmokers may be attracted to firms with workplace smoking bans; and (3) firms with the highest level of environmental tobacco smoke are more likely to ban workplace smoking. However, since the HPL was uniformly enforced nationwide, this introduction is also considered an exogenous factor.

Attributes contains the individual attributes, such as respondent's age, years of education, marital status, the number of housemates (both 20 and over/ under 20), income

(including eight categories[3]), residence city size (both the 13 largest cities/ other cities). *Year* contains the real GDP and unemployment rate in year *t* in order to consider year effects. *Local* contains the prefectural dummy variables. In order to estimate equation (1) by the probit model, *u* is an error term assumed to be distributed normally with $E[u_{it} \mid \mathbf{x_{it}}] = 0$ and $Var[u_{it} \mid \mathbf{x_{it}}] = 1$, where **x** contains all independent variables in equation (1).

3.2 Cross addiction effect

Smoking is well known to be interdependent with other addictive behaviors, which is a phenomenon known as cross addiction. This study also attempts to consider the effect of habitual drinking, which Ida and Goto (2009a) shows to be the addiction with the strongest interdependence with smoking.

This paper simultaneously estimates both equation (1) and the following binary choice model for habitual drinking (equations (2)) by bivariate probit model[4].

$$Drinking_{it}^{*} = \beta_0 + \beta_1 Beertax_t + \beta_2 RTL_t + \beta_3 Attributes_{it} + \beta_4 Year_t + \beta_5 Local_{it} + v_{it}, \quad (2)$$

[3] Income is defined as the pretax respondent's family income in previous year if the main income source of the respondent is his spouse, parents, or other family members. Otherwise, income is defined as the respondent's pretax income in the previous year.

[4] It is also considered to estimate the simultaneous equations system used in Ida and Goto (2009a). However, as Wooldrigde (2001) points out, that specification describes the first-order conditions for an optimization problem, and so any resulting equations cannot be causally interpreted.

$$Drinking_{it} = \begin{cases} 1 & if \quad Drinking_{it}^{*} > 0 \\ 0 & otherwise \end{cases}.$$

Drinking is an indicator of whether individual *i* drinks almost every day or several times a week. *Beertax* is the tax on beer per 1000 liters in year *t*, adjusted to the 2005 prices[5]. *RTL* is an indicator of whether the observations are after year 2002, when the Road Traffic Law was revised[6]. In this case, *u* and *v* are error terms assumed to have a bivariate normal distribution with

$$E[u_{it} \mid \mathbf{x_{it}}] = E[v_{it} \mid \mathbf{z_{it}}] = 0, \tag{3}$$

$$Var[u_{it} \mid \mathbf{x_{it}}] = Var[v_{it} \mid \mathbf{z_{it}}] = 1, \tag{4}$$

$$Cov[u_{it}, v_{it}] = \rho, \tag{5}$$

Where **z** contains all independent variables in equation (2) and ρ is the covariance between *u* and *v*. If ρ equals to zero, bivariate probit model becomes two independent univariate probit models.

In terms of empirical analysis, I estimate separate equations for gender because smoking behavior between males and females is quite different, as pointed out by Bauer et al.(2007) and Stehr (2007), and Lundborg and Andersson (2008), and because male smoking rates are much higher than female ones as shown in Figure 1. Table 2 shows

[5] According to *the Family Income and Expenditure Survey* from the Statistics Bureau, the consumption of sparkling liquor was the highest among alcoholic beverages during 2000-2005.

[6] Penalties for drunk driving have been strengthened in this law revision.

descriptive statistics by gender. Approximately 53 percent of males and 24 percent of females in the sample are habitual smokers, which are both higher than the corresponding rates from the JT (2009). In addition, similar proportions are also habitual drinkers, while the correlation between smoking and drinking are low: 0.046 for males and 0.183 for females.

<Table 2>

4. Data[7]

The main data used in this paper is taken from the Japanese General Social Surveys (JGSS) for 2000, 2001, 2002, 2003, 2005, and 2006. The JGSS are designed and carried out by the JGSS Research Center at Osaka University of Commerce (Joint Usage / Research Center for Japanese General Social Surveys accredited by Minister of Education, Culture, Sports, Science and Technology), in collaboration with the Institute of Social Science at the University of Tokyo. The JGSS survey population consists of men and women aged 20 to 89 as of September 1st of the given survey year, and subjects are selected using a stratified two stage sampling method. The stratification divides Japan into six blocks (Hokkaido/Tohoku, Kanto, Chubu, Kinki, Chugoku/Shikoku, and Kyushu) and then divides each of those blocks into three groups according to the size of cities and districts (largest cities, other cities, and towns/villages). Using census divisions as the sampling unit, survey locations are sampled from each stratum. Data is collected through a combination of

[7] See the JGSS website: http://jgss.daishodai.ac.jp/english/index.html

interviews and self-administered questionnaires. The JGSS survey items are also divided into core questions that appear on every survey and topical questions that appear once or only once in a select number of surveys. Core questions include questions related to the respondent's occupation, household composition, and other basic attributes and questions concerning the respondent's daily activities, basic values and behavioral patterns, political attitudes, and other issues. Topical questions include questions related to events that have attracted public attention at the particular survey point as well as questions that focus on specific themes in order to facilitate focused analysis.

5. Estimation Results

The estimation results are shown in table 3. As *athna* ρ is estimated significantly positive, the results of bivariate probit estimation are mainly presented. Regardless of gender, an increase in cigarette tax and the enlargement of the written health warnings about smoking on packages are found to have notable negative effects on smoking decision. Specifically, marginal effects of the warning are -0.232 for males and -0.201 for females, which are much more than those of cigarette tax, -0.014 for males and -0.02 for females, respectively. On the other hand, the enforcement of the HPL has little effect on smoking for both genders. As for the other independent variables, older, more highly educated, or married individuals have a significantly lower probability of smoking. In addition, males with low- and medium-income and females with housemates aged 20 and more or living in cities have a significantly higher probability of smoking.

<Table 3>

Table4 shows the following elasticities of the policy variables evaluated at sample mean.

$$\varepsilon_C = \frac{\mathrm{d}\Pr(Smoking_{it}=1|\mathbf{x_{it}})}{\mathrm{d}Cigtax_t} \times \frac{\overline{Cigtax_t}}{\overline{Smoking_{it}}} \tag{6}$$

$$\varepsilon_H = \frac{\mathrm{d}\Pr(Smoking_{it}=1|\mathbf{x_{it}})}{\mathrm{d}HPL_t} \times \frac{\overline{HPL_t}}{\overline{Smoking_{it}}} \tag{7}$$

$$\varepsilon_W = \frac{\mathrm{d}\Pr(Smoking_{it}=1|\mathbf{x_{it}})}{\mathrm{d}Warning_t} \times \frac{\overline{Warning_t}}{\overline{Smoking_{it}}} \tag{8}$$

$$\varepsilon_T = \varepsilon_C + \varepsilon_H + \varepsilon_W \tag{9}$$

Equation (9), ε_T, is the total elasticity of smoking control policies that shows that women are more elastic to smoking control policies than men, and it is consistent with previous studies. Namely, the recent policies decrease the smoking rates among males by 13.8 percent and by 30.9 percent among females.

<Table 4>

Table 5 presents the predicted probabilities evaluated at sample mean. As can be seen, individuals who are habitual drinkers have a higher probability of smoking than those who do not drink. In addition, the differences of the predicted probabilities of smoking

conditioned on habitual drinking are by 6.1 percent among males and by 13.5 percent among females, respectively. These differences are considered to support the existence of cross addition effects as found in Ida and Goto (2009a).

<Table 5>

6. Further Empirical Analyses

This section examines the following two aspects of smoking, which have not been analyzed by previous Japanese studies, and uses the same framework as the previous section. Firstly, responses to smoking control policies differ among age groups. Many previous studies outside Japan find that the young are responsive to price changes, while adults are responsive to smoking bans in public spaces (more recently, Carpenter and Cook, 2008; DeCicca and McLeod, 2008; and DeCicca et al., 2008). In this section, I empirically examine the effects of smoking control policies in three age-groups, *the Young* (20s and 30s), *the Middle-aged* (40s and 50s), and *the Elderly* (60 and over). Secondly, I also examine the effects of implementation of the HPL in detail. As the HPL stipulates for regulating smoking only in public spaces, smoking behavior by employment formats may differ after enforcement of the HPL. In other words, smoking rates of individuals who work in the places where the HPL prevents smoking may decrease after 2003, while those who work in other places may hardly change at all. In this section, I also estimate using three employment statuses: *Office workers*, *Manual workers*, and *Non-employed people including the unemployed*. *Manual workers* consists of individuals who work in places that

are not covered by the rules under the HPL; specifically, those occupations are listed in appendix A. On the other hand, *Office workers* are workers other than *Manual workers*.

Table 6 presents descriptive statistics of endogenous variables by age-groups and by employment. As can be seen, smoking rates decrease with the advancement of age and those of the employed are higher than those of the non-employed people.

<Table 6>

6.1 Empirical analyses by age-groups

Table 7A summarizes estimation results of smoking control policies by three age-groups. Cigarette tax has a negative and significant effect on smoking participation except among the elderly males. The marginal effects of cigarette taxes decrease with advancing age, and females are more price elastic than males in each age-group. In addition, for young females and for both middle-aged men and women, enlarging the written health warnings is found to have a definite negative effect on smoking participation. However, the implementation of the HPL has no remarkable effects on smoking choice except for middle-aged females; its marginal effect is approximately -0.178. And *athna* ρ is significantly and positively estimated except among the elderly males.

Table 7B presents elasticities of the policy variables. As can be seen, females are more price elastic than males in each age-group. In the case of males, total effect on the young is approximately seven times larger than that of the middle-aged, while none of the political measures has any effect on the smoking choice of the elderly. On the other hand,

the total effect on the middle-aged females is the largest, followed by that of the young and of the elderly.

Table 7C summarizes predicted probabilities conditioned on the being a habitual drinker. As with the results of the full sample, it is found that individuals who are habitual drinkers have a higher probability of smoking than those who do not drink, and that probability values decrease with advancing of age. In addition, the differences in smoking probabilities of individuals who are or are not habitual drinkers tend to gradually decline with age for both genders. The difference for the young males is 9.8 percent but is very little for the elderly. On the other hand, more than 10 percent differences exist for all age-groups among the females. These results are considered to support the theory that the cross addiction effect for females is larger than that of males.

<Table 7A>

<Table 7B>

<Table 7C>

6.2 Empirical analyses by employment status

Table 8A summarizes the estimation results by employment status. Cigarette tax has a negative and significant effect on smoking participation, except among female manual workers. The marginal effects of cigarette taxes are approximately -0.014 among males and approximately -0.02 among females. The enforcement of the HPL also has a negative and significant effect only on manual workers, while the enlargement of the written health

warnings has the same effect on office workers and non-employed females. And *athna* ρ is significantly and positively estimated except for the male manual workers.

Table 8B presents elasticities of the policy variables. It is found that women are more responsive to policies than men and that elasticities of the non-price factors are much larger than those of cigarette tax for both genders. In addition, Table 8C summarizes predicted probabilities conditioned on being a habitual drinker. For both genders, it is also found that individuals who are habitual drinkers tend to smoke and that the differences in smoking probabilities among those who are habitual drinker and those who are not varies by employment status. In particular, the difference for males is very small, but it is very large for females. These results indicate that a cross addiction effect exists for females.

<Table 8A>

<Table 8B>

<Table 8C>

7. Discussion

This paper is the first study that comprehensively examines the impacts of the recent smoking control policies in Japan on individual's smoking choice. Empirical results using micro-data from nationwide surveys in Japan shows that an increase in cigarette tax and the enlargement of the written health warnings about smoking have negative impacts on the probability of smoking, while the implementation of the HPL has little effect on smoking choice. In addition, it is also found that females are more responsive to these

policies than males. This paper further examines those effects across three age-groups and by three employment statuses. According to the results, the effects of cigarette tax gradually decrease with advancing age. The implementation of the HPL and the enlargement of the written warning on packages have a negative effect on smoking choice among middle-aged female. Moreover the latter also influences that of the young. On the other hand, viewed by employment status, cigarette tax has also significant negative effect on smoking choice, except among female manual workers. The enlargement of written warning on packages also have negative effects on smoking choice among the office workers, while the implementation of the HPL lead to a decline in smoking among manual workers. In particular, the latter result is very interesting in the sense that the implementation of the HPL has a large impact on manual workers who are not covered by the rules under the HPL. However, it is unclear if these results indicate that the implementation of the HPL has little effect on office workers because some companies had restricted employee smoking in the office before 2003 (For example, Morozumi and Ii, 2006), or if the results indicate that manual workers stopped smoking because countermeasures against smoking in public places have been taken nationwide after enforcement of the HPL. The predicted probabilities based on the estimation results shows that individuals who are habitual drinkers have a greater probability of smoking than those who do not drink. In addition, it is also found that the probability of smoking decreases with advancing age and that employed workers are more likely to smoke than non workers, and that these differences are much greater among females than males. These results indicate the existence of a cross addiction effect between smoking and drinking, and thus in the future it will be necessary to design smoking control policies that take the cross addiction effects into consideration.

It is considered that the Japanese government will continue to take anti-smoking policies and evaluate them, as stated in Health Japan 21. On the basis of the results, smoking control policies conducted in recent years are effective for young smokers. Therefore, the regulations pertaining to further increases in cigarette prices, improvement of access for medical treatment for young smokers, which have a larger impact on smoking choices of the young, will contribute to reducing the Japanese smoking rates in the future. In addition, there is still room for improvement in the HPL, which was found to have little effect on smoking, if the law has enforceable penalties by managers of public spaces.

Finally, I wish to mention the two important limitations of this study. Firstly, the following important factors that affect smoking choice are not taken consideration: the individual's smoking history or extent of nicotine addiction, risk and time preferences, and behavioral economics factors. The parameters in this study are biased if the above factors and any of the regressors are correlated. Secondly, it is difficult to identify between the true effects of smoking control policies and yearly effects because they are applied nationwide and concurrently. For example, there is a possibility that using a natural experiment such as the introduction of *Taspo* (where timing of the introduction varies by region) can overcome this problem.

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Appendix A. Occupations Included *Manual workers*

Referring to The Japan Institute for Labor Policy and Training (2004), *Manual workers* are defined as employees whose main workplace is neither a private office or a public place. In particular, the following occupations are included: collectors, hucksters, peddlers, delivery people, routemen, street and door-to door salespeople, news vendors, garbage collectors, insurance agents, insurance brokers, insurance underwriters, childcare workers (private household), cooks (private household), housekeepers (private household), laundresses (private household), maids, servants (private household), farm foremen, farm laborers, gardeners, groundskeepers, stock farmers, forester, fishermen, oyster farmers, taxi drivers, chauffeurs, truck drivers, teamsters, mail carriers, mail handlers, messengers, mining engineers, face workers, coal miners, rock carvers, electric power line worker, cable worker, plasterers, plumbers, pipe filters, bricklayers, stonemasons, civil engineers, road artifices, railroad artifices, foremen, crane operators, derrick operators, hoist operators, chainmen, road worker, construction laborers, millwright, and carpenters.

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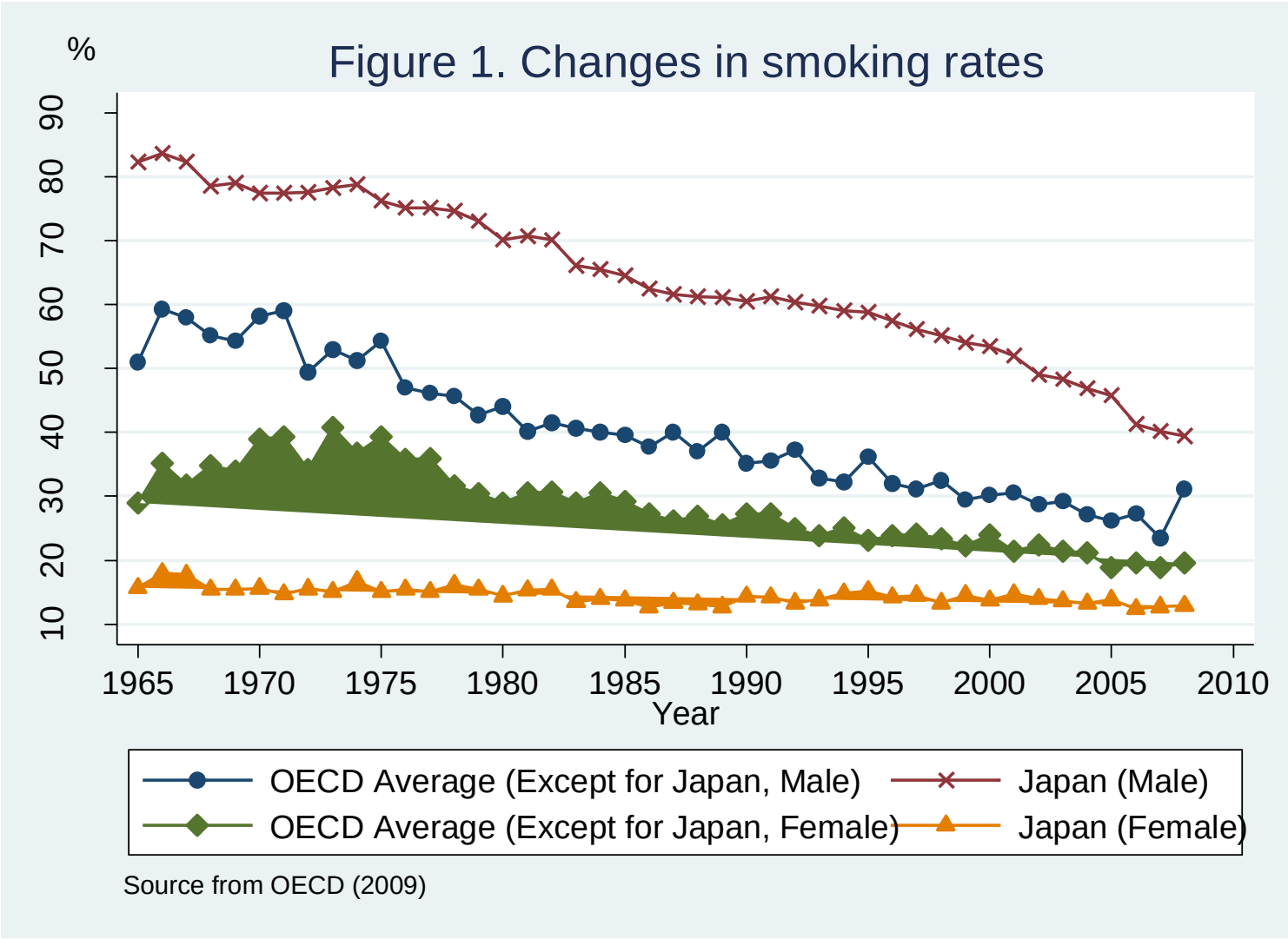

Source from OECD (2009)

Table 1 Recent smoking control policies in Japan

Year/ Month	Regulations
2003/ May	Implementation of the Health Promotion Law.
2003/ July	Increase in the cigarette tax by ¥1 per cigarette.
2005/ April	Enlargement of written warnings about the health risks of smoking on both sides of packages.
2006/ April	Consultations on quitting smoking covered by national health insurance.
2006/ June	Purchase of nicotine patches covered by national health insurance.
2006/ July[1)]	Increase in the cigarette tax by ¥1 per cigarette
2010/ October [2)]	Increase in the cigarette tax by ¥3.5 per cigarette

Note 1) The JT additionally raised cigarette prices by 0.5 yen per cigarette (the JT, 2006).

2) The JT will additionally raise cigarette prices by 1.5 yen per cigarette (the JT, 2010).

Table 2 Descriptive Statistics

Gender	Male				Female			
	Mean	S.D	Min	Max	Mean	S.D	Min	Max
Endogenous variables								
Smoking (=1 if current smoker)	0.531	0.499	0.000	1.000	0.238	0.426	0.000	1.000
Drinking (=1 if drinking more than several times a week)	0.597	0.491	0.000	1.000	0.223	0.416	0.000	1.000
Correlation (*Smoking* & *Drinking*)	0.046				0.183			
Policy variables								
Cigarette tax per pack (Japanese yen)	146.107	13.261	135.146	174.321	140.234	9.969	135.146	174.321
Implementation of the Health Promotion Law	0.347	0.476	0.000	1.000	0.142	0.349	0.000	1.000
Printing health warnings on package	0.228	0.420	0.000	1.000	0.099	0.299	0.000	1.000
Beer tax per 350ml (Japanese yen)	176.465	8.933	167.619	189.094	171.927	6.923	167.619	189.094
Revision of the Road Traffic Law	0.228	0.420	0.000	1.000	0.099	0.299	0.000	1.000
Individual attributes								
Age	53.457	16.023	20.000	89.000	51.771	16.871	20.000	89.000
Years of education	12.268	2.913	6.000	18.000	11.686	2.542	6.000	18.000
Marital status (=1 if married)	0.814	0.389	0.000	1.000	0.698	0.459	0.000	1.000
Number of housemates (Over 20)	1.793	1.133	0.000	7.000	1.666	1.128	0.000	7.000
Number of housemates (Under 20)	0.628	0.978	0.000	6.000	0.672	0.983	0.000	5.000
Residence (in the 13 largest cities)	0.179	0.384	0.000	1.000	0.205	0.404	0.000	1.000
Residence (Other cities)	0.585	0.493	0.000	1.000	0.584	0.493	0.000	1.000
Income								
0- 1 million yen (Reference group)	0.311	0.463	0.000	1.000	0.458	0.498	0.000	1.000
1- 2.5 million yen	0.084	0.277	0.000	1.000	0.150	0.357	0.000	1.000
2.5- 3.5 million yen	0.104	0.305	0.000	1.000	0.088	0.283	0.000	1.000

3.5- 4.5 million yen	0.118	0.323	0.000	1.000	0.062	0.241	0.000	1.000
4.5- 5.5 million yen	0.096	0.295	0.000	1.000	0.059	0.235	0.000	1.000
5.5- 7.5 million yen	0.136	0.343	0.000	1.000	0.074	0.261	0.000	1.000
7.5- 10 million yen	0.097	0.296	0.000	1.000	0.055	0.228	0.000	1.000
More than 10 million yen	0.054	0.226	0.000	1.000	0.055	0.228	0.000	1.000
Year effects								
Real GDP (billion yen)	51.562	1.751	50.162	55.228	50.870	1.306	50.162	55.228
Unemployment rate	4.870	0.393	4.133	5.358	4.865	0.275	4.133	5.358
Number of Observations		4367				2970		

Table 3 Estimation results

Gender	Male			Female		
Model	Probit Model	Bivariate Probit Model		Probit Model	Bivariate Probit Model	
Dependent variable	*Smoking*	*Smoking*	*Drinking*	*Smoking*	*Smoking*	*Drinking*
Policy Variables						
Cigarette tax per pack	-0.014***	-0.014***		-0.020***	-0.020***	
	(0.004)	(0.004)		(0.004)	(0.004)	
Health Promotion Law	-0.021	-0.021		-0.002	-0.007	
	(0.045)	(0.045)		(0.062)	(0.061)	
Health warnings	-0.232**	-0.232**		-0.202***	-0.201***	
	(0.091)	(0.091)		(0.029)	(0.029)	
Individual attributes						
Age	-0.008***	-0.008***	0.002***	-0.006***	-0.006***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Years of education	-0.015***	-0.015***	0.000	-0.019***	-0.019***	0.008**
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Marital status	-0.052**	-0.052**	0.122***	-0.047**	-0.046**	0.089***
	(0.024)	(0.024)	(0.023)	(0.019)	(0.018)	(0.016)
Number of housemates (aged 20 and over 20)	0.002	0.002	-0.016**	-0.015**	-0.015**	-0.008
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Number of housemates (age under 20)	0.003	0.003	0.011	-0.001	-0.002	0.001
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)
Residence (in the 13 largest cities)	-0.012	-0.012	-0.030	0.059*	0.060*	0.080**
	(0.029)	(0.029)	(0.029)	(0.032)	(0.032)	(0.031)
Residence (Other cities)	-0.002	-0.002	-0.012	0.036*	0.038*	0.025
	(0.020)	(0.020)	(0.019)	(0.021)	(0.021)	(0.020)
Income categories						
1- 2.5 million yen	0.090***	0.090***	0.045	-0.001	-0.002	0.047*

	(0.031)	(0.031)	(0.030)	(0.025)	(0.025)	(0.026)
2.5- 3.5 million yen	0.077**	0.077**	0.093***	0.019	0.020	0.063*
	(0.031)	(0.031)	(0.028)	(0.032)	(0.032)	(0.033)
3.5- 4.5 million yen	0.071**	0.071**	0.106***	-0.036	-0.037	0.005
	(0.030)	(0.030)	(0.027)	(0.032)	(0.032)	(0.035)
4.5- 5.5 million yen	0.095***	0.095***	0.108***	-0.022	-0.024	0.075*
	(0.031)	(0.031)	(0.029)	(0.033)	(0.032)	(0.039)
5.5- 7.5 million yen	0.027	0.027	0.161***	0.008	0.006	0.017
	(0.029)	(0.029)	(0.025)	(0.033)	(0.033)	(0.032)
7.5- 10 million yen	0.060*	0.060*	0.164***	-0.013	-0.014	0.048
	(0.031)	(0.031)	(0.026)	(0.036)	(0.036)	(0.038)
More than 10 million yen	0.005	0.005	0.184***	-0.014	-0.014	-0.003
	(0.038)	(0.038)	(0.030)	(0.036)	(0.036)	(0.035)
Drinking equation						
Beer tax per 350ml			0.003			-0.007
			(0.003)			(0.004)
Revision of the Road Traffic Law			-0.136***			-0.155***
			(0.069)			(0.044)
athna ρ		0.095***			0.262***	
		(0.025)			(0.039)	
ρ		0.094			0.257	
		(0.025)			(0.037)	
Log pseudolikelihood	-2790.909	-5623.258		-1275.001	-2710.553	
Wald test: $\chi^2(65)$/ $\chi^2(129)$	438.58***	661.80***		636.49***	842.92***	
Wald test for year effects: $\chi^2(2)$	46.82***	46.67***		134.05***	133.76***	
Wald test for local effects: $\chi^2(46)$	64.41**	64.30**		72.28***	71.46***	
Wald test of ρ=0 : $\chi^2(1)$		14.07***			44.20***	

Note (1) Robust standard errors are enclosed in parentheses.

(2) ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.
(3) All equations include the year effects and the local effects.

Table 4 Elasticities and total effects of the smoking control policies

Gender	*Cigtax* (ε_C)	*HPL* (ε_H)	*Warning* (ε_W)	Total Effects (ε_T)
Male	-0.038	*NS*	-0.100	-0.138
Female	-0.143	*NS*	-0.166	-0.309

Note (1) All elasticities are evaluated at the sample mean.

(2) *NS* represents that the estimated parameters are "not significant".

Table 5 Predicted probabilities

Estimation		Male	Female
Probit Model	Pr(smoke=1)	0.5343	0.1944
Bivariate Probit Model	Pr(smoke=1)	0.5343	0.1940
	Pr(smoke=1|drink=1)	0.5585	0.3015
	Pr(smoke=1|drink=0)	0.4979	0.1666
	Difference	0.0606	0.1349

Note (1) All predicted probabilities are evaluated at the sample mean.

(2) *Difference* is defined as: *Difference* = Pr(smoke=1|drink=1) - Pr(smoke=1|drink=0)

Table 6 Descriptive statistics of endogenous variables for further analyses

		Smoking		*Drinking*		Correlation	N
Gender	Sample	Mean	S.D	Mean	S.D		
Male	Age-groups						
	Young (aged 20- 39)	0.694	0.461	0.500	0.500	0.109	994
	Middle-aged (aged 40- 59)	0.575	0.495	0.674	0.469	0.034	1639
	Elderly (over 60)	0.396	0.489	0.578	0.494	0.041	1734
	Employment formats						
	Office workers	0.561	0.496	0.618	0.486	0.042	2209
	Manual workers	0.637	0.481	0.639	0.480	-0.019	893
	Non-employed people	0.402	0.491	0.528	0.499	0.046	1265
Female	Age-groups						
	Young (aged 20- 39)	0.358	0.480	0.264	0.441	0.169	830
	Middle-aged (aged 40- 59)	0.235	0.424	0.275	0.447	0.159	1077
	Elderly (over 60)	0.149	0.356	0.138	0.345	0.170	1063
	Employment formats						
	Office workers	0.282	0.450	0.275	0.447	0.173	1285
	Manual workers	0.262	0.441	0.272	0.446	0.231	206
	Non-employed people	0.197	0.398	0.171	0.377	0.163	1479

Table 7 Further analysis by age-groups

A. Estimation results

Estimation model		Probit Model			Bivariate Probit Model				
Gender	Sample	*Cigtax*	*HPL*	*Warning*	*Cigtax*	*HPL*	*Warning*	*athna ρ*	*ρ*
Male	*Young*	-0.025***	0.118	-0.632***	-0.025***	0.115	-0.632***	0.199***	0.196
		(0.007)	(0.089)	(0.149)	(0.007)	(0.089)	(0.148)	(0.058)	(0.056)
	Middle-aged	-0.011*	-0.031	-0.130	-0.011*	-0.031	-0.129	0.069*	0.069
		(0.006)	(0.074)	(0.157)	(0.006)	(0.074)	(0.157)	(0.042)	(0.042)
	Elderly	-0.009	-0.088	-0.091	-0.009	-0.088	-0.093	0.026	0.026
		(0.006)	(0.066)	(0.147)	(0.006)	(0.066)	(0.147)	(0.040)	(0.040)
Female	*Young*	-0.031***	0.207	-0.343**	-0.031***	0.209	-0.340***	0.275***	0.268
		(0.009)	(0.142)	(0.091)	(0.008)	(0.141)	(0.092)	(0.068)	(0.063)
	Middle-aged	-0.016**	-0.178**	-0.231***	-0.015**	-0.179***	-0.229***	0.225***	0.221
		(0.006)	(0.047)	(0.026)	(0.006)	(0.045)	(0.026)	(0.063)	(0.060)
	Elderly	-0.003***	-0.002	-0.013	-0.013***	0.012	-0.060	0.302***	0.293
		(0.017)	(0.021)	(0.084)	(0.004)	(0.076)	(0.048)	(0.084)	(0.077)

Note: See Table 3.

B. Elasticities and total effects of the smoking control policies

Gender	Sample	*Cigtax*	*HPL*	*Warning*	Total Effects
Male	*Young*	-0.050	*NS*	-0.151	-0.201
	Middle-aged	-0.027	*NS*	*NS*	-0.027
	Elderly	*NS*	*NS*	*NS*	0.000
Female	*Young*	-0.136	*NS*	-0.204	-0.340
	Middle-aged	-0.116	-0.187	-0.252	-0.555
	Elderly	-0.222	*NS*	*NS*	-0.222

Note: See Table 4.

C. Predicted probabilities

		Probit Model	Bivariate Probit Model			
Gender	Sample	Pr(smoke=1)	Pr(smoke=1)	Pr(smoke=1|drink=1)	Pr(smoke=1|drink=0)	Difference
Male	*Young*	0.7364	0.7348	0.8064	0.7081	0.098
	Middle-aged	0.5795	0.5796	0.5938	0.5491	0.045
	Elderly	0.3887	0.3887	0.3953	0.3794	0.016
Female	*Young*	0.3290	0.3285	0.4617	0.2876	0.174
	Middle-aged	0.1849	0.1840	0.2627	0.1567	0.106
	Elderly	0.0128	0.0827	0.1817	0.0715	0.110

Note: See Table 5.

Table 8 Further analysis by employment formats

A. Estimation results

Estimation model		Probit Model			Bivariate Probit Model				
Gender	Sample	*Cigtax*	*HPL*	*Warning*	*Cigtax*	*HPL*	*Warning*	*athna ρ*	*ρ*
Male	*Office workers*	-0.014***	-0.004	-0.343***	-0.014***	-0.004	-0.344***	0.111***	0.110
		(0.005)	(0.065)	(0.120)	(0.005)	(0.065)	(0.119)	(0.036)	(0.035)
	Manual workers	-0.014*	-0.172*	-0.176	-0.014*	-0.172*	-0.174	0.035	0.035
		(0.008)	(0.102)	(0.220)	(0.008)	(0.102)	(0.220)	(0.060)	(0.060)
	Non-employed people	-0.013*	-0.013	-0.160	-0.013*	-0.014	-0.160	0.085*	0.085
		(0.007)	(0.078)	(0.168)	(0.007)	(0.078)	(0.167)	(0.047)	(0.046)
Female	*Office workers*	-0.023***	-0.060	-0.305***	-0.022***	-0.065	-0.303***	0.234***	0.229
		(0.006)	(0.096)	(0.027)	(0.006)	(0.094)	(0.027)	(0.058)	(0.055)
	Manual workers	0.008	-0.282***	0.252	0.001	-0.240***	0.433	1.055***	0.784
		(0.016)	(0.075)	(0.707)	(0.014)	(0.066)	(0.703)	(0.253)	(0.098)
	Non-employed people	-0.019***	0.058	-0.125***	-0.018***	0.056	-0.124**	0.262***	0.256
		(0.004)	(0.091)	(0.050)	(0.004)	(0.090)	(0.050)	(0.060)	(0.056)

Note: See Table 3.

B. Elasticities and total effects of the smoking control policies

Gender	Sample	*Cigtax*	*HPL*	*Warning*	Total Effects
Male	*Office workers*	-0.035	*NS*	-0.131	-0.166
	Manual workers	-0.032	-0.091	*NS*	-0.122
	Non-employed people	-0.047	*NS*	*NS*	-0.047
Female	*Office workers*	-0.135	*NS*	-0.297	-0.431
	Manual workers	*NS*	-0.904	*NS*	-0.904
	Non-employed people	-0.177	*NS*	*NS*	-0.177

Note: See Table 4.

C. Predicted probabilities

Gender	sample	Probit Model Pr(smoke=1)	Bivariate Probit Model Pr(smoke=1)	Pr(smoke=1|drink=1)	Pr(smoke=1|drink=0)	Difference
Male	*Office workers*	0.5665	0.5667	0.5933	0.5228	0.071
	Manual workers	0.6636	0.6635	0.6709	0.6499	0.021
	Non-employed people	0.3974	0.3971	0.4216	0.3696	0.052
Female	*Office workers*	0.2332	0.2325	0.3265	0.2008	0.126
	Manual workers	0.1237	0.1087	0.4066	0.0313	0.375
	Non-employed people	0.1450	0.1442	0.2496	0.1266	0.123

Note: See Table 5.