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The Effect of Smoking Habit on Labor Productivity: Empirical Evidence from the United States and Japan

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Abstract

This paper investigates the effect of smoking habit on regular employees' labor productivity by using individual data from the General Social Surveys (GSS) and the Japanese GSS (JGSS). In addition, the smoking control policies implemented in both countries are applied in order to control the endogenous problem of smoking habit and to examine the effects on smoking participation. The main results are as follows. First, the negative biases on smoking are verified but the size is negligible in the GSS samples. Second, as a result of controlling the endogeneity of smoking, there are few differences in wages due to smoking in all groups. Third, the smoking control policies in both countries have an impact on male employees' smoking participation. Finally, the results indicated that the behavioral addiction model is more suitable for explaining the actual smoking behavior in greater detail than the rational addiction model, as pointed out in recent studies on addiction.

Key words: smoking habit; labor productivity; smoking control policies; behavioral addiction model

JEL Classification Number: C31; I10; I18; J31; J32

1. Introduction

In modern society, it is well known that smoking causes serious diseases and health problems not only for smokers but also for nonsmokers through passive smoking. In order to reduce health damages from smoking, *The Framework Convention on Tobacco Control* was ratified at the 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, as summarized in the WHO Regional Office for Europe (2002): further, despite differences among all states, each state in the United States individually imposes several smoking restrictions. On the other hand, in Japan, whose smoking rates are much higher than those of the other developed countries due to its lower cigarette taxes and prices and backward smoking control policies, it is only recently that the government began to promote measures to limit the health problems caused due to smoking through the "National Health Promotion in the 21st century (Health Japan 21)."

In addition, some economic studies on smoking point out that smoking not only causes health problems but also involves some social costs[1], such as (1) the direct medical costs of preventing, diagnosing, and treating smoking related diseases; (2) the indirect morbidity costs associated with the lost earnings from work attributable to smoking; (3) the indirect mortality costs related to the loss of future earnings due to premature smoking-produced deaths; and (4) decreasing productivity due to the number and length of smoking breaks during working hours (Chaloupka and Warner, 2000).

The main purpose of this paper is to investigate the effect of smoking habits on regular employees' labor productivity. For example, the wage system, which is often regarded as an indicator of labor productivity, is not generally considered to differ according to lifestyles.

[1] In contrast, the pension benefit and medical expenditure to smokers are sometimes treated as the social benefits of smoking. The former is estimated by Shoven et al. (1989), and the latter by Manning et al. (1991), Barendreg et al. (1997), and Warner et al. (1999). They all report that the net costs are negative.

Therefore, if the labor productivity of smokers is less than that of nonsmokers, the difference can be interpreted as the cost that firms employing smokers implicitly bear. Furthermore, this cost will be medium- or long-term, depending on how long these firms continue to employ smokers, because smoking behavior is addictive.

Studies on the social cost of smoking can be classified into two main groups: those estimating the social cost of smoking using simulation techniques and those undertaking empirical analyses of the relationship between smoking habits and labor productivity. The former studies indicate that the social cost of smoking is too large to be ignored, although the definitions of the cost and estimation methods differ.

On the other hand, based on empirical analyses using large-scale individual data, most of the latter studies find that the productivity of smokers is less than that of nonsmokers. Using wages or work absence as the indicator of labor productivity, these studies regress these dependent variables on the smoking dummy and other individual characteristics. However, it should be noted that they have some analytical problems. First, the estimation results may be biased because most of them treat the smoking habit as an exogenous factor. Since the decision making of smoking participation or behavior is determined by various socio-economic factors, the smoking habit should be treated as an endogenous variable in econometric analysis. Otherwise, there exists the possibility of misinterpreting the results and policy recommendations. To solve this analytical problem, Leigh (1995) and Lye and Hirschberg (2004) apply the sample selection model to directly control the endogeneity of the smoking habit, and Levin et al. (1997) use individual panel data to control the individual's potential heterogeneity. Leigh (1995) finds that smoking appears to raise the absence rates for men and women, and Levin et al. (1997) also find that the wages of smokers are significantly 4 -8% less than those of nonsmokers and that the wages decrease by 6.3% if a nonsmoker becomes a smoker. However, Lye and Hirschberg (2004) find that smoking has no significant effect on income. In fact, there is no agreement on the effect of smoking on labor productivity. However,

we must be careful when interpreting these three studies, because they have other critical econometric problems. In particular, all the estimates in Leigh (1995) and Lye and Hirshberg (2004) may be inconsistent because some of the independent variables used as excluded variables in the smoking participation equation, such as wages and lifestyle habits, seem to be considered as endogenous variables. On the other hand, as Levin et al. (1997) pointed out, on account of data limitations, they may not eliminate the potential bias resulting from the unobserved heterogeneity. Second, these econometric studies apply the framework of the rational addiction model (Becker and Murphy, 1988). However, according to recent economic studies on addiction, since the rational addiction model has limitations in explaining the actual smoking behavior, there is growing emphasis on the behavioral addiction model, which includes behavioral economic factors (O'Donoghue and Rabin, 1999; Gruber and Koszegi, 2001, 2004; Bernheim and Rangel, 2004, 2005; Gruber and Mullainathan, 2005; Kan, 2007). To the extent of my knowledge, the effects of smoking on labor productivity from the perspective of behavioral economics have not been studied thus far. Finally, econometric studies have only focused on the relative differences in the labor productivity between smokers and nonsmokers. However, since the values of the differences are considered to be the greatest benefit of implementing various smoking control policies and regulations, estimating the values is also important and useful for considering not only smoking bans in the workplace but also smoking control policies at the national level.

The organization of this paper is as follows. Section 2 briefly summarizes some related previous studies. Section 3 describes the data and estimation strategies used in this study. Section 4 presents the estimation results. Section 5 summarizes the results of this study and discusses some policy implications on smoking.

2. Previous Studies[2]

In this section, some previous studies relevant to this paper are summarized before presenting the detailed analyses. As mentioned in the previous section, these studies can be classified into two main groups: those estimating the social costs of smoking by using simulation techniques and those undertaking empirical analyses of the relationship between smoking habit and labor productivity.

The former group is further classified into three subgroups. The first group consists of Weis (1981) and the Institute for Health Economics and Policy (1997) that estimated the social cost of smoking by using aggregated data. Weis (1981) indicated that the additional cost of employing smokers is $4,611 per smoker in one year (in 1981), and the Institute for Health Economics and Policy (1997) indicated that the total social loss of cigarettes is about 3.8 trillion yen (in 1993). The second group constitutes Manning et al. (1991) and Viscusi (1995) who used the individual data of the National Health Interview Surveys (NHIS) and RAND Health Insurance Experiment (HIE)[3]. Manning et al. (1991) indicated that the externality cost of smoking ranged from – $0.91 to $0.24 (in 1986) per pack of cigarettes. Viscusi (1995) added the effect of environmental tobacco smoke (EST) to this analysis and indicated that the net cost of smoking was $0.42 to $0.72 per pack. The third group comprises Evans, Ringel, and Stech (1999), Ogura, Kadoda, and Izumida (2005), and Sugawara and Ohkusa (2006) who used their econometric results from individual data. Evans, Ringel, and Stech (1999) used the Natality Detail data file in 1994 and indicated that the externality cost was $0.42 to $0.72 (in 1994). Ogura, Kadoda, and Izumida (2005) used the claim, health check-up, and health insurance data and indicated that the medical costs rise by 1.67 times when a nonsmoker

[2] Chaloupka and Warner (2000) conducted the most comprehensive survey of economic studies on smoking behavior and the supply and demand for cigarettes. Moreover, Lancaster and Lancaster (2003) surveyed the relationship between the advertising regulations on cigarettes and smoking behavior. More recently, Bernheim and Rangel (2005) surveyed the studies on addictive behavior from the perspective of behavioral economics.

[3] See Newhouse et al. (1993).

becomes a smoker and 1.15 times when a smoker becomes a nonsmoker. Sugawara and Ohkusa (2006) used their original survey data and examined the cost-benefit analysis of smoking cessation programs. In that process, they estimated that the social cost of smoking is about 8.7 trillion yen.

On the other hand, Ault et al. (1991), Manning et al. (1991), Leigh (1995), Levin et al. (1997), French et al. (2001), Moore and Hughes (2001), Rizzo (2001), and Lye and Hirschberg (2004) examine the effect of smoking on labor productivity. Ault et al. (1991) tested the hypothesis that smoking is causally related to absenteeism, using the 1986 Panel Study of Income Dynamics. Estimating by the Tobit Model, they found that smoking did not affect absenteeism. However, testing the differences in the means of independent variables between smokers and nonsmokers, they found significant differences in age, occupation, tenure, and gender. Therefore, they concluded that the fact that smokers are absent more often than nonsmokers is not because of the smoking habit but because of their individual characteristics. Manning et al. (1991) examined the effect of smoking on work loss using the HIE data from 1974 through 1978. The coefficient on the smoking dummy is not significant in the result of the Negative Binomial Regression Model. However, they also found that the nonsmokers who live with smokers are absent from work more often than those who live with nonsmokers, which can be attributed to passive smoking. French et al. (2001) examined the relationship between the number of cigarettes per day and workplace absenteeism, by using original survey data from workers in hospitals and schools in the district. By using the Negative Binomial Regression Model, it was found that an increase in the number of daily cigarettes raises full and partial absenteeism by 1 - 2% for both genders. Moore and Hughes (2001) analyzed the relationship between smoking and work absence, using the data from the 1987 National Medical Expenditure Survey. The results of using a whole sample indicated that the smokers and ex-smokers respectively miss work 30% and 50% more than nonsmokers. The results using the sample of workers only revealed that the smokers miss work 1.5 days more than

nonsmokers. Rizzo (2001) used the 1987 National Medical Expenditure Survey to examine the effect of smoking on the absence rates. Using the Logit Model, the respective absence rates of male and female heavy smokers under the age of 40 are 1.47 and 1.35 times more than that of nonsmokers. Moreover, it was found that the absence rates of ex-smokers aged over 40 are 1.39 times more than those of nonsmokers.

However, as stated in the previous section, there are some analytical problems in these studies: (1) the estimation results may be biased because most of them treat the smoking habit as an exogenous factor; (2) these econometric studies apply the framework of the rational addiction model, in which is difficult to explain the actual smoking behavior; and (3) most of the empirical studies have only focused on the relative differences in the labor productivity between smokers and nonsmokers. In particular, to solve the first problem, Leigh (1995) and Lye and Hirschberg (2004) apply the sample selection model to directly control the endogeneity of smoking habit, and Levin et al. (1997) use the individual panel data to control the individual's potential heterogeneity. Leigh (1995) examined the relationship between smoking and the absence rate using the 1986 Panel Study of Income Dynamics and found that the true effect of smoking on the absence rate is 1.05% for males and 0.13- 0.29% for females. This is respectively 0.72% and 0.91- 1.07% lower than when endogenous problem is not taken into consideration. Levin et al. (1997) used the data from the 1984 and 1992 National Longitudinal Survey of Youth to examine the effect of smoking on wages. The results suggested that the wages of smokers are significantly 4- 7% less than those of nonsmokers and that the wages decrease by 6.3% if a nonsmoker becomes a smoker. On the other hand, Lye and Hirschberg (2004) examined the relationship between the smoking and annual income using the data from the 1989 and 1990 Australian National Household Survey and concluded that no significant difference between smokers and nonsmokers existed because the coefficient of the inverse mills ratio is insignificant. However, as mentioned in the previous section, although these studies also have other critical econometric problems, we must be careful in the

interpretation of their results: (1) all the estimates in Leigh (1995) and Lye and Hirshberg (2004) may be inconsistent because some of the independent variables used as excluded variables in the smoking participation equation seem to be considered as endogenous variables and (2) as Levin et al. (1997) point out, because of data limitations, they may not eliminate the potential bias due to the unobserved heterogeneity. Based on the above observations, this paper uses another econometric model that can deal with the abovementioned analytical problems and investigates the effect of smoking habit on labor productivity.

3. Data and Estimation Strategies

3.1. Data

The main data used in this paper are taken from the General Social Surveys (GSS) and the Japanese GSS (JGSS). The GSS is a nationally representative survey that has been conducted repeatedly by the University of Chicago National Opinion Research Center for most years since 1972[4] up to 2006, and has been administrated 26 times to over 45,000 respondents. On the other hand, the JGSS, which is modeled considerably after the GSS, is designed and carried out at the Institute of Regional Studies at the Osaka University of Commerce in collaboration with the Institute of Social Science at the University of Tokyo[5]; from 2000 to 2005, it has been administrated five times to over 14,000 respondents. The JGSS has many questionnaires in common with the GSS and offers the advantage of easily examining

[4] The GSS will switch from a repeating, cross-sectional design to a combined repeating cross-sectional and panel-component design. The 2006 GSS will be the base year for the first panel. A sub-sample of 2006 GSS cases (most likely about 2000) will be selected for reinterviews in 2008 and again in 2010 as part of the GSSs in those years.

[5] The JGSS are designed and carried out under the direction of Ichiro Tanioka, Michio Nitta, Hiroki Sato, and Noriko Iwai with Project Manager, Minae Osawa. The project is financially assisted by Gakujutsu Frontier Grant from the Japanese Ministry of Education, Culture, Sports, Science and Technology for academic years 1999- 2003, and the datasets are compiled and distributed by the SSJ Data Archive, Information Center for Social Science Research on Japan, Institute of Social Science, the University of Tokyo.

international comparisons with the other countries in which similar surveys are conducted[6]. Therefore, the results of comparing the countries with high and low smoking rates will reveal not only the difference in smoking behavior based on nationalities but also important policy implications for Japanese smoking control policies in the future. In addition, the JGSS also focuses on studying the attitudes and behavior of the Japanese people comprehensively. Meanwhile, I use the GSS data from 1977 to 1994 because the questions about smoking behavior were raised in only these periods and the JGSS from 2002 to 2005 because of data limitations of other important regressors. The main descriptions of these surveys are summarized in Table 1[7].

< Insert Table 1 here >

Figure 1 presents a comparison of the changes in the smoking participation rates between the United States and Japan taken from the *OECD Health Data 2007* ("Male (USA)," "Female (USA)," "Male (JPN)," and "Female (JPN)"), the GSS, and the JGSS. According to this, the rates of males from the GSS fluctuate at an average of 8.2 percent points higher and those of females fluctuate at an average of 4.7 percent points higher than the OECD data over the periods. On the other hand, although the rates of the males from the JGSS fluctuate at an average of 3.8 percent points lower than the OECD, those of females do at the same level as hat of the OECD. However, since the GSS and the JGSS data have downward trends and do not lose touch with the OECD, they are considered to be valid enough to analyze the relationship between labor productivity and smoking habit.

[6] Surveys similar to the GSS are also conducted in Ireland, Britain, Australia, Canada, Germany, Taiwan, Korea, and countries other than Japan. For example, Gruber and Mullainathan (2005) use the GSS and the Canadian GSS to assess and compare the effect of cigarette taxes on well-being.

[7] See the following websites for more detailed information.
GSS: http://www.norc.org/projects/General+Social+Survey.htm
JGSS: http://www.jgss.daishodai.ac.jp/

< Insert Figure 1 here >

3.2. Estimation Models

Following previous studies, this paper uses employees' wages as the indicators of labor productivity[8]. Therefore, the dependent variable is the logarithm of hourly wages (ln[*hwage*]), which is the pre-tax income in the previous year divided by both 52 (weeks) and by the weekly working hours just before the survey[9]. However, the pre-tax income is a categorical variable, and therefore, the mean of each interval is used for the income value[10]. Based on the Mincer earning function, the following wage equation is defined.

$$\ln[hwage_{it}] = \alpha_0 + \alpha_1 Smoke_{it} + \boldsymbol{\alpha}_2' \mathbf{x}_{it} + u_{it} \quad (1)$$

where *Smoke* is the smoking indicator, and **x** is the vector of various explanatory variables. If the respondent is a current smoker, *Smoke* is equal to 1. If the wages of smokers are less than those of nonsmokers, α_1 is expected to be negative. Assuming the Mincer earning function, **x** includes *Education*, *Tenure*, *Squared tenure*, and various individual characteristics, such as job status (*Self-employed*, *Large company*, and *Manual worker*[11]), health condition (*Unhealthy*),

[8] Although the information on absence from work, which is another indicator of labor productivity in the previous studies, is also available from the GSS and the JGSS, this paper does not use it because this question relates only to the period just before the survey and because of the inability to identify and verify whether the employees who are on sick leave.

[9] The wages are adjusted to price in 2000 by using the GDP implicit price deflators. In addition, it is noted that hourly wages may not be the proper indicator of productivity in a strict sense because they is calculated mechanically and there is a time lag between the alteration of income and weekly working hours.

[10] We can only know and use the real values in the highest category from the JGSS.

[11] Referring to *Occupational Reference Book* published by the Japan Institute for Labor Policy and Training, in this paper, manual workers are defined as employees whose main workplace is not the private office or the public place. In particular, the following occupations are included: collectors, hucksters, peddlers, delivery men, routemen, street and door-to door sales workers, news vendors, junkmen, 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,

the other individual attribute (*Self-control problem*[12], *Stress*, *Father's education*, *Mother's education*, *White*, and *Black*), and the scales of residence (*Large city* and *City*), as summarized in Table 2. In addition, the major industry effects[13], two macroeconomic factors, and local effects[14] are also included in **x**[15]. Moreover, the macroeconomic factors are the GDP implicit price deflator and the unemployment rate obtained from the *OECD Health Data 2007*: the GDP implicit price deflator captures the price variations effects and the unemployment rate the business cycle effects in the period. As a general approach, the survey year dummy variables are used to consider these macroeconomic factors when using the repeated cross section data. However, this paper uses these variables expediently because the survey year dummies are required for controlling the endogenous problem of smoking habit, as expounded in the next subsection. Further, u is the error term, and the subscript i is the individual indicator.

< Insert Table 2 here >

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groundkeepers, stock farmers, forester, fishermen, oyster farmers, taxicab drivers, chauffeurs, truck drivers, teamsters, mail carriers, mail handlers, messengers, mining engineer, face workers, coal getters, rock carvers, electric power linemen, cable men, plasterers, plumbers, pipe filters, bricklayers, stonemasons, civil engineers, road artifices, railroad artifices, foremen, crane operators, derrick operators, hoist operators, chainmen, roadmen, construction laborers, millwright, and carpenters.

[12] In this paper, an individual with self-control problems is defined as a current smoker who has attempted to quit smoking. In addition, in order to estimate all the parameters, nonsmokers are included in this group albeit with some reservations, which is not always a correct assumption. The reason behind doing so is that there are no variables during the periods to identify whether each nonsmoker has self control problems.

[13] The major industry effects are as follows: in the GSS samples, based on the "not classified industries," the indicators of "agriculture, forestry, and fisheries," manufacturing, "transportation, communications, and other public utilities," wholesale, retail trade, "finance, insurance, and real estate, business and repair services," "entertainment and recreation services, professional and related services," and public administration. On the other hand, in the JGSS samples, based on the "not classified industries," the indicators of agriculture, forestry, fisheries, industrials, construction, manufacture, energy (electricity, gas, and heat services) and water, transport, wholesale, retailing, restaurant, finance and insurance, reality, mass media, information and communication, medical and human services, education and research services, legal and accounting services, and public services. The summary statistics and their estimation results are not reported due to space limitations.

[14] With regard to the JGSS female, since the sample size is too small, the clustering robust standard errors are computed in order to take account of correlated error terms within prefectures.

[15] Moreover, the dummy variables of the latest appointments (executive, department head, section head, subsection head, and foreman) are included in the JGSS samples.

3.3. Endogenous Problem of Smoking Habit

Since the decision making of smoking participation or behavior is determined by various socio-economic factors, these variables must be treated as endogenous variables in econometric analysis. In order to control this problem, this paper simultaneously estimates both the productivity and smoking participation equations. When doing so, it is extremely important to use the new strictly exogenous variables except for **x** in the smoking participation equation. In this paper, the state and federal cigarette taxes per package (*Cigarette taxes*) taken from *The Tax Burden on Tobacco* by the Tobacco Institute are added on the GSS data, while the smoking control policies implemented in 2003 (*Smoking control policies*), introducing the Health Promotion Law[16] in May and increasing the cigarette taxes by 1 yen per cigarette[17] in July, are added on the JGSS data as the variables that satisfy the above condition. According to various previous studies on the effects of smoking control policies, these policies significantly reduce the demand for smoking[18]. Then, if we ignore their effects and solely estimate the wage equations, the coefficients on *Smoke* will be negatively biased.

However, it is necessary to carefully consider whether these smoking control policies should indeed be treated as exogenous variables. For instance, some studies treated cigarette price as an endogenous variable because cigarette manufacturers in the Unites States can determine it. In fact, Harris (1987) pointed out that the main component of increasing cigarette

[16] Article 25 of the Health Promotion Law establishes that caretakers and managers of schools, gymnasiums, hospitals, theaters, assembly halls, exhibition halls, department stores, business offices, government and other public offices, and restaurants must take precautions to prevent passive smoking.

[17] Other recent smoking control policies in Japan are as follows: obliging to print warnings about health hazards of smoking on cigarette packages in April 2005; including the consultation on quitting smoking in the national health insurances in April 2006; including the purchase of nicotine patches in the national health insurances in June 2006; and increasing cigarette taxes by 1 yen per cigarette in July 2006. In addition, bans on smoking and the separation of smoking areas are being promoted by some local governments, working places, and public spaces. For example, in October, 2002, Chiyoda Ward in Tokyo first introduced fines on smoking on the streets.

[18] Chaloupka and Warner (2000) summarized many previous studies conducted before 1999, which examined the effects of various smoking control policies on cigarette demand or its consumption. Further, more recently, Saffer and Chaloupka (2000), Yurekli and Zhang (2000), Emery et al. (2001), Moore and Hughes (2001), Tauras and Chaloupka (2001), DeCicca et al. (2002), Glied (2002), Farrelly et al. (2003), Shue et al. (2004), Powell et al. (2005), Adda and Cornaglia (2006), and Morozumi and Ii (2006) also investigated these effects.

prices was not the increased federal excise tax in 1983, but a rapid expansion in the wholesale prices charged by major Unites States cigarette manufacturers. In addition, as Evans, Farrelly, and Montgomery (1999) pointed out, smoking restrictions such as the Health Promotion Law will generate a potential for the self-selection bias; to elaborate, (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 ETS are more likely to ban workplace smoking.

However, as with many previous studies, cigarette taxes in the Unites States are the appropriate exogenous factors because they are independently determined only by the governments. On the other hand, Japanese smoking control policies implemented in 2003 are uniformly enforced nationwide at the same time, and the cigarette prices are also the approved prices that are uniformly applied nationwide. Therefore, the smoking control policies in both countries can be considered as exogenous factors[19]. Then, the smoking participation equation is defined as below, and both equations (1) and (2) are estimated by the Treatment Effect Model.

$$Smoke_{it}^{*} = \beta_0 + \boldsymbol{\beta}_1^{'}\mathbf{x}_{it} + \boldsymbol{\beta}_2^{'}\mathbf{z}_{it} + v_{it} \tag{2}$$

where $\mathbf{z}$ is the vector of exclusion variables as shown in the lower end of Table 2, which includes the policy variable (*Cigarette taxes* or *Smoking control policies*), some respondents' family characteristics that may affect the smoking behavior, and the interactions between the policy variable and some independent variables such as *Education*, *Manual worker*, *Self control problem*, *Large city*, and *City*. If smoking control policies reduce the probability of smoking participation, the coefficients on those variables are expected to be negative. On the other hand, the interactions are added to control other factors of individual heterogeneity, which may affect both labor productivity and smoking participation. For example, years of

[19] However, I can only examine their total effects because the data are from 2002 to 2005.

education is known not only to highly influence productivity but also to determine smoking participation, because less educated individuals may not recognize the effects of smoking. Hence, *Education* is a proxy for the knowledge of smoking in the smoking participation equation. On the other hand, with regard to manual workers, it is generally known that their smoking rate is greater and their hourly wages are less than those of office workers. In addition, they are considered as the control group of smoking bans such as the Health Promotion Law, which prevents people from smoking in the public places or private offices. Therefore, there is a strong possibility that *Education* and *Manual worker* affect both labor productivity and smoking participation. In addition, *Self-control problem* is the behavioral economic variable to be used as the proxy for hyperbolic discounting, which leads to time- inconsistent preferences. Recently, behavioral economic perspectives have gained considerable importance in studies on addiction; examples are studies by O'Donoghue and Rabin (1999), Gruber and Koszegi (2001, 2004), Bernheim and Rangel (2004, 2005), Gruber and Mullainathan (2005), and Kan (2007). In particular, smokers with self-control problems will quit smoking due to the environmental changes that assist smokers to quit, and the productivity of these unenduring people will be originally low. Hence, there is also a fair possibility that the behavioral economic variables will affect both labor productivity and smoking participation. Further, v is the disturbance in the smoking participation equation, and u and v are assumed to satisfy the following conditions.

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

$$\mathrm{var}[u_{it} \mid \mathbf{x_{it}}, \mathbf{z_{it}}] = \sigma$$

$$\mathrm{E}[v_{it} \mid Smoke_{it}, \mathbf{x_{it}}, \mathbf{z_{it}}] = 0$$

$$\mathrm{var}[v_{it} \mid Smoke_{it}, \mathbf{x_{it}}, \mathbf{z_{it}}] = 1$$

$$\mathrm{cov}[u_{it}, v_{it}] = \rho$$

If the coefficient on *Smoke* is negatively biased, the estimate of ρ is negatively significant. As estimated by Leigh (1995), French et al. (2001), and Rizzo (2001), I estimate separately by gender because it is considered that the effects of education and experience on

productivity and smoking behavior differ between males and females.

4. Estimation Results

4.1. Welch's Tests

Table 3 describes the summary statistics of the main independent variables[20]. Additionally, the right -hand side in Table 3 shows the results of the mean comparison tests (Welch's test) between smokers and nonsmokers. The GSS samples reveal that for both genders, nonsmokers' hourly wages are higher than those of smokers; in particular, $1.02 higher for males and $1.69 higher for females. On the other hand, although nonsmokers' wages are 24 yen higher than those of smokers among the Japanese males, there are no significant differences in Japanese females. In fact, these results show that smokers' labor productivity is significantly lower than that of nonsmoker, with the exception of Japanese women. However, it is necessary to consider the results of the empirical analyses before being able to undertake accurate discussions, because these mean comparison tests do not consider the effects of the other individual characteristics on productivity but compare only the mean differences in individual characteristics by smoking habit. On the other hand, as for the individual characteristics, American male nonsmokers appear to be more educated, more likely to work for themselves, and to have more housemates, while their smoking counterparts appear to be more experienced, more likely to be manual workers, and to have more children. In addition, American female nonsmokers appear to be more educated while the smokers appear to be less healthy and more likely to experience stress in their work. On the other hand, Japanese male nonsmokers appear to be more educated and experienced and more likely to work for themselves while smokers are more likely to be manual workers, to experience stress in their work, and have self-control problems. Finally, Japanese female nonsmokers appear to be more

[20] Individuals who are absent from working just before the survey are excluded because their hourly wages are overestimated. Additionally, individuals with missing variables are excluded.

experienced and more likely to have spouses and more housemates while smokers appear to be less healthy and more likely to experience stress in their work.

In addition, as shown in Table.1, the sample sizes of the JGSS are much smaller than those of the GSS, because it has not been long since the JGSS has been surveyed. Therefore, since there is a possibility that the standard errors in the JGSS samples may be not precisely estimated, we should heed the interpretation of the estimation results of the JGSS.

< Insert Table 3 here >

4.2. Estimation Results of OLS

The OLS estimation results of wage equations are reported in Table 4. Although the coefficients on *Smoke* among American females and the Japanese (both genders) are insignificant, and as expected, that for the American males is negatively significant. Particularly, the American male smoker's wages are about 4.69% (= exp (– 0.048) – 1) less than that of nonsmokers although there are no differences in productivity in the other groups. However, since the endogenous problem of smoking habit is not considered in these OLS estimations, all of the coefficients will be negatively biased. Hence, the results of another approach that controls the problem are shown in the next subsection.

< Insert Table 4 here >

4.3. Estimation Results of the Treatment Effect Model

< Insert Table 5 here >

Table 5 shows the estimation results of the Treatment Effect Model. Unlike with the OLS estimation results, there is no difference in wages between smokers and nonsmokers among American workers of both genders and Japanese females, while smoking has a negatively significant effect on the productivity of Japanese males. Moreover, the estimates of ρ in the GSS samples are all negative, which indicates that the OLS estimators are negatively biased and are adjusted by applying the Treatment Effect Model. However, since they are not significant, the size of bias is negligible. In addition, Japanese male smokers' wages are as less as 50.24% (= exp(– 0.698) – 1) than those of nonsmokers, while smoking does not affect labor productivity in the other groups. In this regard, the difference in expected wages in the Treatment Effect Model is defined as (Greene, 2003);

$$\begin{aligned}\ln(Dhwage_{it}) &= \mathrm{E}[\ln(hwage_{it}) \mid Smoke_{it} = 1, \mathbf{x_{it}}, \mathbf{z_{it}}] - \mathrm{E}[\ln(hwage_{it}) \mid Smoke_{it} = 0, \mathbf{x_{it}}, \mathbf{z_{it}}] \\ &= \alpha_1 + \rho\sigma\left[\frac{\phi(\boldsymbol{\beta}'\mathbf{X_{it}})}{\Phi(\boldsymbol{\beta}'\mathbf{X_{it}})\{1-\Phi(\boldsymbol{\beta}'\mathbf{X_{it}})\}}\right] \qquad (3)\end{aligned}$$

$$where, \quad \boldsymbol{\beta} \equiv (\beta_0 \ \boldsymbol{\beta}_1 \ \boldsymbol{\beta}_2)$$

$$\mathbf{X_{it}} \equiv (1 \ \mathbf{x_{it}} \ \mathbf{z_{it}})$$

where, ln(*Dhwage*) is the difference in expected wages, φ is the standard normal density, and Φ is the standard normal cumulative distribution function. Therefore, in order to gauge whether the wage differences truly exist, it is necessary to consider the estimates of ρ, σ, and the parameters of the smoking participation equations. In this regard, the estimates of both *atanhρ*[21] and lnσ are significant for the Japanese males but only lnσ is significant for the other groups. In addition, except for the Japanese male sample, the null hypothesis that two error

[21] *atanhρ* is defined as $atanh\rho = \frac{1}{2}\ln\left(\frac{1+\rho}{1-\rho}\right)$

terms are not correlated cannot be rejected by the likelihood ratio (LR) test. Therefore, although the wage differences for the other groups are merely α_1, which are not significant, as shown in Table 5, the mean of ln(*Dhwage*) for Japanese males is estimated at – 0.0101 and its standard error is 0.0016, which indicates that the hourly wages of the Japanese male smoker is significantly about 1% less than that of the nonsmokers and that the average wage difference is estimated at 21 yen (in 2000)[22]. Since this difference is not considered as being so large, these results indicate that there are few differences in the wages due to smoking in all groups. However, as the causes will be examined later again, it must be noted that the coefficients on Smoke in the Japanese samples are strangely large and that ρ is positively estimated.

The results of other independent variables in the wage equations are likely to remain unchanged in the results of the OLS estimations for all samples. First, more experienced individuals earn more income; however, its increase rate diminishes for all samples because *Tenure* is positively significant and *Squared tenure*, negatively significant. As for the American males, people with more educated or living in the large city earn more wages while the hourly wages of the manual workers, African-Americans, or employees under work stress, or those with self-control problems are lower. As for the American females, more educated women, those living in large cities, and Caucasians earn more wages; however, the hourly wages of self employed people, manual workers, or employees under job stress are lower. In addition, as for the Japanese samples, *Self-employed* for males and *Mother's education* for females are positively significant.

On the other hand, in smoking participation equations, both *Cigarette taxes* and *Smoking control policies* significantly reduce male smoking participation, and its marginal effects are –0.013 in the Unites States and –0.320 in Japan. This implies that the 1 cent cigarette tax increase reduces the American male employee's probability of smoking by 1.3%[23]

[22] Since both exp(E[*hwage*| *Smoke* = 1, **x**, **z**]) and exp(E[*hwage*| *Smoke* = 0, **x**, **z**]) are estimated as being 0.2328 and 0.2349, respectively, the wage difference is calculated as 0.0021 and its standard error is 0.001.

[23] According to Evans, Ringel, and Stech (1999), and Chaloupka and Warner (2000), a basis for a

and that the smoking control policies implemented in 2003 reduce the Japanese male employee's probability of smoking by 32.0%. However, it must be noted that the marginal effects on *Smoking control policies* are strangely large and so are the odd estimation results of the coefficient on *Smoke* and ρ. Unlike with the Unites States, since most of the policies in Japan including the Health Promotion Law and the increase of the cigarette taxes are uniformly implemented nationwide at the same time, *Smoking control policies* only has the time series variations and may include the effects of the other unobserved year effects that are not captured by macroeconomic factors: the GDP implicit price deflator and the unemployment rates. Then, *Smoking control policies* may not be sufficient to control the endogeneity of the smoking habit in the JGSS samples.

The results of other independent variables in the smoking participation equations are mostly consistent with those obtained by previous studies. Overall, more educated people or those living with spouses, juveniles, or other housemates tend not to smoke, because the coefficients on *Education* or the family structures are negatively significant. Additionally, more experienced individuals seem to be more likely to smoke; however, the increase rate of smoking diminishes since *Tenure* is positively significant and *Squared tenure*, negatively significant. Moreover, self-employed people, except for American females, are not more likely to smoke. On a gender basis, first, the men with self-control problems significantly have a greater probability of smoking, although this is the opposite in the results for females. In particular, in the results of the GSS for males, since the interaction of *Cigarette taxes* and *Self-control problem* is also negatively significant, the smoking control policies are particularly effective for individuals with self-control problems, which is consistent with the results of recent studies on addiction. This indicates that the behavioral addiction model is better for explaining the actual smoking behavior in more detail than the rational addiction model, as pointed out in recent studies on addiction. Second, smoking control policies significantly

consensus that the price elasticity of cigarette demand is around 0.0 to −0.25 among adults and −0.5 to −0.7 among the younger people.

reduce the males' smoking participation rates but not that of females. However, female smoking rates in both countries are originally low, as shown in Figure 1 and Table 3, and there is little difference in the marginal effect of *Cigarette taxes* in both genders in the results of the GSS. These results indicate that it is considered that the standard error of *Cigarette taxes* of the American females may be overestimated, which implies that the marginal effect may not be precisely estimated although the cigarette tax increase may actually reduce smoking rates among American females.

5. Conclusions

This paper investigates the effect of smoking habit on the regular employees' labor productivity by using individual data from the GSS and JGSS. However, since the decision making of smoking participation is determined by various socio-economic factors, this variable must be treated as an endogenous variable in econometric analysis. In this paper, the state and federal cigarette taxes per package and the smoking control policies implemented in 2003 are applied both to control the endogenous problem of smoking habit and to examine the effects on smoking participation.

According to the estimation results of the OLS and Treatment Effect Model, these negative biases on smoking are verified but the size of it is negligible in the GSS samples. Moreover, the hourly wages of Japanese male smokers are significantly about 1% less than those of nonsmokers and the wage difference is estimated at 21 yen (in 2000), while there are no statistically significant differences in wages between smokers and nonsmokers in the other groups. However, since the difference of Japanese males is not thought of as being so large, these results indicate that there are few differences in the wages due to smoking in all groups. Meanwhile, the social cost of smoking of Japanese males is calculated at 38,178 yen (= 21

(yen/h) * 151.5 (h)[24] * 12 (months)) per year, which can be considered as the greatest benefit of reducing a smoker. In addition, according to the results of the smoking participation equations, smoking control policies in both countries have an impact on male employees' smoking participation; in particular, the smoking restrictions reduce the probabilities of becoming a smoker by 1.3 percent points in the Unites States and by 32 percent points in Japan. Additionally, with regard to the Japanese smoking control policy, according to previous studies, the enforcement level of the Health Promotion Law is "extensive.[25]" Therefore, in order to reduce the social costs of smoking or to make the smoking rates as low as that of other developed countries, increasing cigarette taxes rather tightening smoking bans in spaces will prove to be more effective. Moreover, increasing cigarette taxes is expected to be able to prevent youths and young adults from smoking more than ever. In addition, since the men with self-control problems significantly have a greater probability of smoking and the interaction of *Cigarette taxes* and *Self-control problem* is also negatively significant, the results also show that anti-smoking restrictions are particularly effective for individuals with self-control problems. This indicates that the behavioral addiction model is better for explaining the actual smoking behavior in greater detail than the rational addiction model, as pointed out in recent studies on addiction. In addition, although the cigarette tax increase may also reduce the American females' smoking rates, the marginal effect may not be precisely estimated because the smoking rates among this group are originally low.

Finally, some limitations of this paper are summarized for future studies. First, in this paper, smokers are defined as current smokers, although the labor productivity and social cost of smoking will actually differ with respect to the number of daily cigarettes, smoking intensity

[24] According to the 2005 *Monthly Labor Survey* by the Ministry of Health, Labor and Welfare, the average monthly hours worked per regular employee from 2002 to 2005 is 151.5.

[25] Chaloupka (1992) or Chaloupka and Wechsler (1997) categorize the levels of smoking restrictions as follows: the "nominal restrictions" limit smoking in one to three public places excluding restaurants and private worksites; the "basic restrictions" regulate smoking in four or more public places excluding restaurants and private worksites; the "moderate restrictions" regulate smoking in restaurants but not in private worksites; and the "extensive restrictions" regulate smoking in private worksites.

(Adda and Cornaglia, 2006), or smoking duration. Hence, it would also be interesting for future studies to examine the effects of differences in the definitions of smoking habits. Second, as with Levin et al. (1997), there may be a potential bias in the estimates because the information related to smoking from the GSS and the JGSS pertains to whether or not the respondent smokes (smoked) and whether or not the smoking respondent has attempted to quit smoking. Then, it is clear that in this paper, those independent variables that may affect smoking participation are less than those in the previous studies. Therefore, the estimates may be biased if those omitted factors correlate with the other independent variables[26]. Third, the marginal effects on *Smoking control policies* are strangely large and so are the odd estimation results of the coefficient on *Smoke* and ρ in the results of the Treatment Effect Model on the Japanese samples. Unlike with the Unites States, since most of the policies in Japan are uniformly implemented nationwide at the same time, *Smoking control policies* only has time series variations and the effects of the other unobserved year effects may be included in this variable. Thus, this variable may not be sufficient to control the endogeneity of the smoking habit. Fourth, due to the data limitation, the nonsmokers with self-control problems cannot be identified. However, this is one of the most important independent variables for applying the behavioral addiction framework, such as Gruber and Koszegi (2001), Gruber and Mullainathan (2005), or Kan (2007). Hence, it is necessary for future research to accurately identify them. Finally, in the analysis on the JGSS, this paper investigated the total effects of the Health Promotion Law and the cigarette tax increase due to the data limitations. However, examining each effect separately would also be interesting in relation to the smoking policies in Japan.

[26] This paper does not consider them because the estimation equations are more complex. However, for example, the drinking habit is known to be strongly correlated to smoking habit (Chaloupka and Warner, 2000; Cook and Moore, 2000) and also affects labor productivity (Berger and Leigh, 1988; French and Zarkin, 1995; Dave and Kaestner, 2002).

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Figure 1. *Smoking participation rates in the United States and Japan*

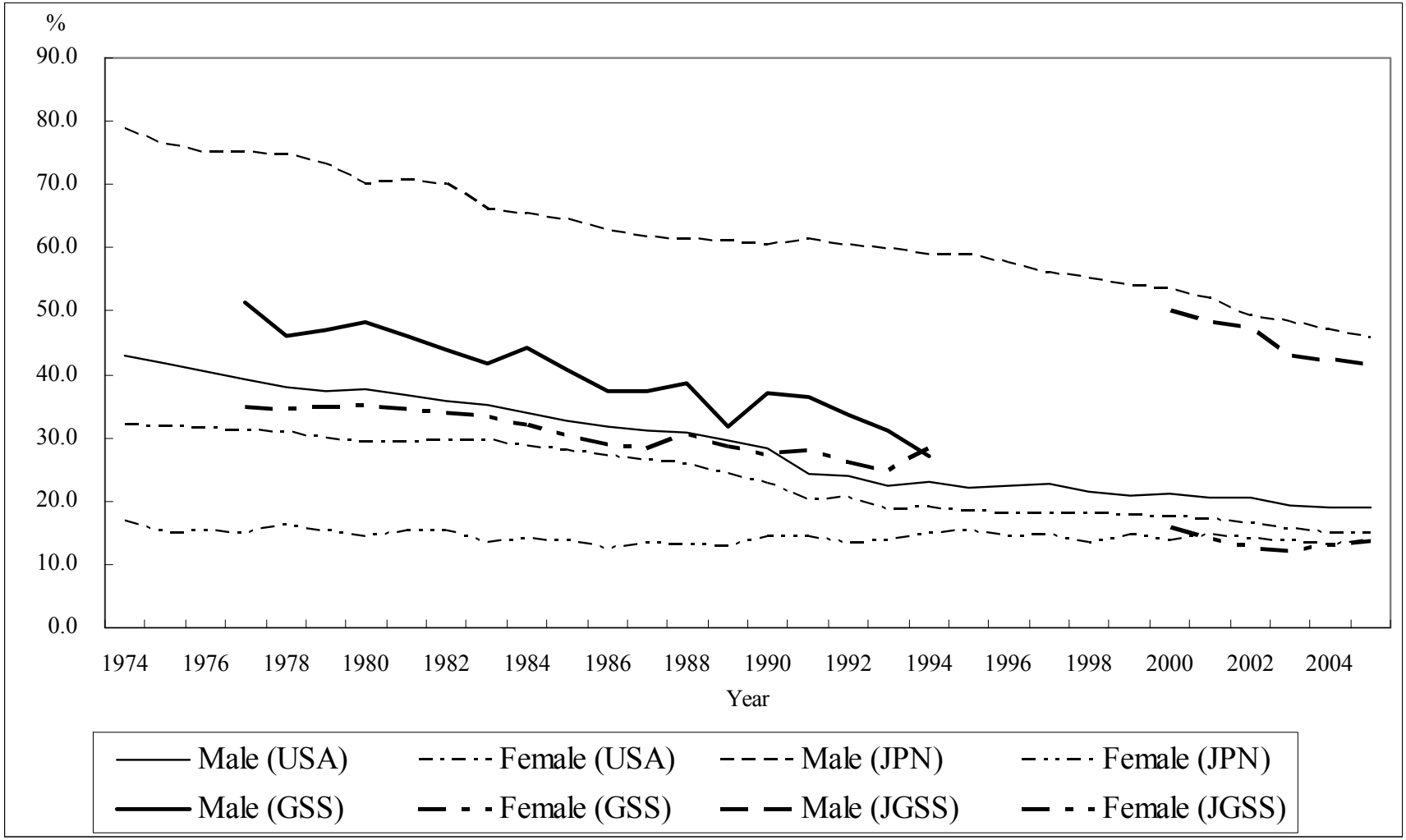

Table 1. *Main descriptions of the GSS and the JGSS*

Title	GSS	JGSS
Geographical coverage	United States	Japan
Population	All noninstitutionalized, English-, and Spanish-speaking persons 18 year of age or older, living in the United States	Men and women 20– 89 years of age, living in Japan
Smallest geographical unit	Census region	Census region
Sampling method	Block quota sampling (1972, 1973, and 1974), a combination of block quota and full probability sampling (1975 and 1976), and full probability sampling (1977, 1978, 1980, 1982- 1991, and 1993– 2006).	Two-stage stratified random sampling; stratified by regional block and population size
Time period	1972– 2006	2000– 2005
Date(s) of collection	February, March, and April of 1972 -1978, 1980, 1982 -1991, 1993, 1994, 1996, 1998, 2000, 2002, 2004, and 2006.	November of 2000 -2003, and August, September, October, and November of 2005.
Mode of data collection	Face-to-face and computer-assisted personal interviews	Face-to-face interview and placement method
Response rates	Approximately 71%	50.5– 64.9%

Table 2. *Definitions of the main independent variables*

Variable	Data		Definitions
Independent variables	GSS	JGSS	
Education	○	○	the respondent's years of schooling
Tenure	○	○	the respondent's age - *Education* - 6
Self-employed	○	○	= 1 if the respondent is a self-employed worker
Large company		○	= 1 if the respondent works in a company with more than 1,000 employees
Manual worker	○	○	= 1 if the respondent is a manual worker, which is defined in detail in footnote 11
Unhealthy	○	○	= 1 if the respondent's health is not good or bad
Self control problem	○	○	= 1 if the respondent is considered to have self control problems, which is defined in detail in footnote 12
Stress	○	○	= 1 if the respondent experiences stress in his/her work
Father's education	○	○	years of the respondent's father's education
Mother's education	○	○	years of the respondent's mother's education
White	○		= 1 if the respondent is Caucasian.
Black	○		= 1 if the respondent is African-American.
Large city	○		= 1 if the respondent lives in the central city of 12 largest SMSAs in the United States
		○	= 1 if the respondent lives in any of the 13 major cities in Japan
City	○		= 1 if the respondent lives in a central city of the remainder of the100 largest SMSAs in the United States
		○	= 1 if the respondent lives in a city other than the 13 major cities in Japan
Exclusive variables			
Cigarette taxes	○		the state and federal cigarette taxes per package
Smoking control policies		○	= 1 if the observations are in the 2003 and 2005 survey
Marriage	○	○	= 1 if the respondent is married
Children	○	○	the number of children under 18 years of age in the family
Family size	○	○	the number of persons living with the respondent, excluding *Children*

Table 3. *Summary statistics and the mean comparison tests*

Panel A: GSS

Gender	Male							Female						
	Nonsmoker		Smoker		Welch's tests			Nonsmoker		Smoker		Welch's tests		
Dependent variables	Mean	S.D.	Mean	S.D.	Differences		S.E.	Mean	S.D.	Mean	S.D.	Differences		S.E.
Hourly wages (dollars)	18.511	14.274	17.489	15.209	1.021	*	0.523	12.052	11.873	10.360	6.397	1.692	***	0.338
Independent variables														
Education	14.248	2.806	13.072	2.805	1.175	***	0.098	14.049	2.490	12.953	2.161	1.096	***	0.094
Tenure	18.508	11.801	19.489	11.545	– 0.982	**	0.407	18.576	11.963	17.975	11.250	0.601		0.477
Self-employed	0.160	0.367	0.122	0.328	0.038	***	0.012	0.070	0.256	0.066	0.248	0.005		0.010
Manual worker	0.168	0.374	0.211	0.408	– 0.043	***	0.014	0.062	0.242	0.051	0.221	0.011		0.009
Unhealthy	0.007	0.081	0.007	0.083	0.000		0.003	0.005	0.069	0.013	0.114	– 0.008	*	0.004
Self-control problem	0.772	0.420	0.665	0.472	0.107	***	0.016	0.840	0.366	0.635	0.482	0.206	***	0.019
Stress	0.122	0.327	0.132	0.338	– 0.010		0.012	0.112	0.315	0.137	0.344	– 0.025	*	0.014
Father's education	11.203	3.768	10.533	3.937	0.670	***	0.136	11.299	3.802	10.564	3.642	0.735	***	0.154
Mother's education	11.455	2.903	10.967	2.847	0.488	***	0.100	11.448	3.028	11.087	2.952	0.361	***	0.124
White	0.905	0.293	0.905	0.293	0.000		0.010	0.863	0.344	0.884	0.320	– 0.022		0.014
Black	0.068	0.252	0.074	0.262	– 0.006		0.009	0.104	0.306	0.092	0.289	0.012		0.012
Large city	0.064	0.245	0.069	0.253	– 0.005		0.009	0.079	0.269	0.078	0.268	0.001		0.011
City	0.121	0.326	0.116	0.321	0.005		0.011	0.144	0.351	0.166	0.372	– 0.022		0.015
Exclusive variables														
Cigarette taxes	52.407	15.615	47.656	11.821	4.751	***	0.458	52.232	15.224	48.951	12.664	3.281	***	0.557
Marriage	0.678	0.468	0.681	0.466	– 0.004		0.016	0.515	0.500	0.480	0.500	0.035	*	0.021
Children	0.878	1.155	0.984	1.201	– 0.105	**	0.042	0.778	1.057	0.838	1.064	– 0.061		0.044
Family size	2.033	0.742	1.980	0.709	0.053	**	0.025	1.898	0.793	1.945	0.876	– 0.047		0.036
Number of observations	2735		1161					2330		761				

Note: (1) The means and the standard deviations of *Smoke* is (0.298, 0.457) for males and (0.246, 0.431) for females.

(2) ***, **, and * represent statistically significant at 1, 5, 10% levels, respectively.

(3) The major industry effects, some macroeconomic factors, and local effects are not reported due to space limitations.

Table 3. *Summary statistics and the mean comparison tests (continued)*

Panel B: JGSS

Gender	Male							Female						
	Nonsmoker		Smoker		Welch's tests			Nonsmoker		Smoker		Welch's tests		
Dependent variables	Mean	S.D.	Mean	S.D.	Differences		S.E.	Mean	S.D.	Mean	S.D.	Differences		S.E.
Hourly wages (1,000 yen)	0.271	0.168	0.247	0.162	0.024	**	0.011	0.167	0.120	0.152	0.095	0.015		0.014
Independent variables														
Education	13.636	2.698	12.952	2.370	0.684	***	0.167	13.031	2.175	13.079	1.517	– 0.049		0.229
Tenure	29.313	13.651	26.800	12.839	2.513	***	0.872	26.444	13.991	19.270	10.756	7.174	***	1.581
Self-employed	0.176	0.381	0.117	0.322	0.059	**	0.023	0.125	0.332	0.111	0.317	0.014		0.044
Large company	0.174	0.379	0.170	0.376	0.004		0.025	0.125	0.332	0.095	0.296	0.030		0.042
Manual worker	0.168	0.374	0.216	0.412	– 0.048	*	0.026	0.085	0.279	0.079	0.272	0.005		0.038
Unhealthy	0.139	0.346	0.145	0.352	– 0.006		0.023	0.132	0.339	0.286	0.455	– 0.154	**	0.061
Self-control problem	0.458	0.499	0.526	0.500	– 0.068	**	0.033	0.912	0.284	0.571	0.499	0.340	***	0.065
Stress	0.098	0.298	0.143	0.350	– 0.044	**	0.022	0.064	0.246	0.175	0.383	– 0.110	**	0.050
Father's education	10.321	3.373	9.989	3.075	0.333		0.212	10.695	3.232	11.032	3.182	– 0.337		0.443
Mother's education	9.708	2.709	9.600	2.590	0.108		0.174	10.037	2.609	10.429	2.619	– 0.391		0.363
Large city	0.182	0.386	0.161	0.368	0.021		0.025	0.200	0.401	0.238	0.429	– 0.038		0.059
City	0.587	0.493	0.607	0.489	– 0.020		0.032	0.631	0.483	0.571	0.499	0.059		0.069
Exclusive variables														
Smoking control policies	0.534	0.499	0.515	0.500	0.019		0.033	0.549	0.498	0.603	0.493	– 0.054		0.069
Marriage	0.892	0.311	0.860	0.348	0.032		0.022	0.725	0.447	0.492	0.504	0.233	***	0.069
Children	0.793	1.002	0.816	0.976	– 0.023		0.065	0.505	0.845	0.698	0.978	– 0.193		0.133
Family size	1.947	1.205	1.943	1.231	0.004		0.080	2.095	1.377	1.587	1.227	0.508	***	0.174
Number of observations	489		435					295		63				

Note: (1) The means and standard deviations of *Smoke* is (0.471, 0.499) for males and (0.176, 0.381) for females.

(2) ***, **, and * represent statistically significant at 1, 5, 10% levels, respectively.

(3) The major industry effects, latest appointments indicators, some macroeconomic factors, and local effects are not reported due to space limitations.

Table 4. *Estimation results of the OLS*

Data	GSS						JGSS					
Gender	Male			Female			Male			Female		
	M.E.		S.E.	M.E.		S.E.	M.E.		S.E.	M.E.		S.E.
Smoke	– 0.048	*	0.026	– 0.021		0.029	– 0.028		0.035	0.023		0.066
Education	0.097	***	0.005	0.101	***	0.006	0.026	***	0.009	0.045	**	0.020
Tenure	0.056	***	0.004	0.042	***	0.004	0.038	***	0.006	0.041	***	0.009
Squared tenure (*1/100)	– 0.077	***	0.008	– 0.063	***	0.009	– 0.057	***	0.011	– 0.070	***	0.020
Self-employed	0.057		0.042	– 0.154	**	0.069	0.014		0.077	0.042		0.170
Large company							0.187	***	0.041	0.122		0.110
Manual worker	– 0.091	***	0.031	– 0.128	**	0.061	– 0.089		0.056	– 0.046		0.134
Unhealthy	– 0.289		0.241	0.042		0.127	– 0.054		0.049	– 0.029		0.092
Self-control problem	– 0.045	*	0.025	– 0.022		0.029	– 0.047		0.035	– 0.023		0.097
Stress	– 0.146	***	0.036	– 0.121	***	0.044	– 0.140	***	0.053	– 0.210	*	0.106
Father's education	0.003		0.004	– 0.001		0.004	– 0.003		0.008	– 0.007		0.014
Mother's education	0.005		0.005	– 0.001		0.006	0.014		0.010	0.033	*	0.017
White	– 0.037		0.079	0.150	**	0.071						
Black	– 0.157	*	0.089	0.045		0.079						
Large city	0.094	*	0.048	0.135	***	0.049	– 0.012		0.070	0.227	*	0.125
City	0.020		0.036	0.032		0.037	0.046		0.048	0.118		0.078
Constant	1.259	***	0.204	0.192		0.220	– 0.007		6.373	– 16.718		10.015
Log likelihood / R-squared	– 3955.905 / 0.2875			– 3072.217 / 0.2512			– 629.185 / 0.3938			– 301.735 / 0.3430		
F-test (zero slope)	F(72,3823) = 20.52***			F(72,3018) = 13.44***			F(85,838) = 9.67***			F(31,45) = 103.28***		

Notes: (1) All standard errors except for the JGSS female are heteroskedasticity robust standard errors.

(2) The standard errors of the JGSS female are clustering robust standard errors in prefectures.

(3) ***, **, and * represent statistically significant at 1, 5, and 10% levels, respectively.

(4) The equations of the GSS data include the major industry dummies, some macroeconomic factors, and local effects dummies.

(5) The equation of the JGSS male includes some macroeconomic factors and the indicators of the major industries, latest appointments, and local effects.

(6) The equation of the JGSS female includes some macroeconomic factors and indicators of the major industries and latest appointments.

Table 5. *Estimation results of the Treatment Effect Model*

Panel A: GSS

Gender	Male				Female			
Dependent Variable	ln(*hwage*)		*Smoke*		ln(*hwage*)		*Smoke*	
Independent Variables	M.E.	S.E.	M.E.	S.E.	M.E.	S.E.	M.E.	S.E.
Smoke	0.029	0.112			0.043	0.142		
Education	0.099 ***	0.006	– 0.070 ***	0.011	0.103 ***	0.007	– 0.022 *	0.013
Tenure	0.055 ***	0.004	0.014 ***	0.002	0.041 ***	0.004	0.007 ***	0.003
Squared tenure(*1/100)	– 0.075 ***	0.008	– 0.027 ***	0.005	– 0.062 ***	0.009	– 0.022 ***	0.006
Self-employed	0.061	0.042	– 0.059 ***	0.022	– 0.154 **	0.068	0.011	0.034
Manual worker	– 0.093 ***	0.031	– 0.104	0.065	– 0.127 **	0.060	– 0.001	0.124
Unhealthy	– 0.290	0.239	0.006	0.097	0.031	0.128	0.166	0.111
Self-control problem	– 0.042 *	0.025	0.189 ***	0.053	– 0.011	0.038	– 0.305 ***	0.089
Stress	– 0.148 ***	0.036	0.017	0.023	– 0.123 ***	0.043	0.034	0.025
Father's education	0.003	0.004	0.006 **	0.003	– 0.001	0.004	– 0.003	0.003
Mother's education	0.004	0.005	0.004	0.003	– 0.001	0.006	0.006 *	0.003
White	– 0.033	0.078	– 0.092 *	0.055	0.149 **	0.070	0.017	0.046
Black	– 0.152 *	0.089	– 0.072	0.049	0.047	0.078	– 0.035	0.049
Large city	0.091 *	0.047	– 0.123	0.086	0.132 ***	0.048	0.083	0.178
City	0.018	0.036	– 0.012	0.091	0.029	0.037	0.111	0.108
Constant	1.207 ***	0.214	2.400 ***	0.701	0.140	0.242	1.151	0.876
Exclusion Variables								
Cigarette taxes			– 0.013 ***	0.003			– 0.002	0.004
Marriage			– 0.016	0.026			– 0.053 ***	0.017
Children			0.004	0.007			– 0.005	0.009
Family size			– 0.046 ***	0.012			0.008	0.011
(Interactions)								
Education			0.001 ***	0.000			0.000	0.000
Manual worker			0.003 *	0.002			0.000	0.002
Self-control problem			– 0.005 ***	0.001			0.002	0.001
Large city			0.003	0.002			– 0.001	0.003
City			0.001	0.002			– 0.001	0.002
athna ρ (ρ)	– 0.070	0.097	(– 0.070)	(0.097)	– 0.058	0.121	(– 0.058)	(0.120)
ln σ (σ)	– 0.402 ***	0.022	(0.669)	(0.015)	– 0.424 ***	0.024	(0.654)	(0.016)
Log likelihood	– 6008.136				– 4553.8499			
Wald test (zero slope)	chi2(72) = 1508.21***				chi2(72) = 990.79***			
Wald test (ρ = 0)	chi2(1) = 0.52				chi2(1) = 0.23			

Notes: (1) All standard errors are heteroskedasticity robust standard errors.

(2) ***, **, and * represent statistically significant at 1, 5, and 10% levels, respectively.

(3) The equations include the major industry dummies, some macroeconomic factors, and local effects dummies.

Table 5. *Estimation results of the Treatment Effect Model (continued)*

Panel B: JGSS

Gender	Male				Female			
Dependent Variable	ln(*hwage*)		*Smoke*		ln(*hwage*)		*Smoke*	
Independent Variables	M.E.	S.E.	M.E.	S.E.	M.E.	S.E.	M.E.	S.E.
Smoke	– 0.698 ***	0.099			– 1.008	0.688		
Education	0.005	0.011	– 0.045 ***	0.011	0.022	0.026	– 0.003	0.014
Tenure	0.041 ***	0.007	0.008	0.006	0.046 ***	0.008	0.016 *	0.009
Squared tenure(*1/100)	– 0.067 ***	0.012	– 0.023 **	0.010	– 0.091 ***	0.020	– 0.038 **	0.019
Large Company	– 0.082	0.083	– 0.141 **	0.068	0.081	0.164	– 0.030	0.033
Self-employed	0.134 **	0.053	– 0.094 *	0.050	– 0.029	0.145	– 0.080 *	0.045
Manual worker	– 0.060	0.063	0.003	0.063	– 0.064	0.138	– 0.062 **	0.025
Unhealthy	– 0.052	0.056	– 0.004	0.050	0.116	0.113	0.314 ***	0.115
Self-control problem	0.003	0.041	0.085 *	0.047	– 0.438	0.318	– 0.364 ***	0.132
Stress	– 0.081	0.059	0.092 *	0.053	– 0.029	0.235	0.122	0.078
Father's education	– 0.008	0.009	– 0.010	0.008	– 0.009	0.019	0.000	0.008
Mother's education	0.019	0.012	0.012	0.011	0.039 **	0.020	0.009	0.008
Large city	0.015	0.078	– 0.010	0.084	0.237	0.149	– 0.008	0.072
City	0.075	0.053	– 0.006	0.061	0.071	0.103	– 0.094 *	0.054
Constant	– 0.227	7.347	– 3.848	5.725	– 8.517	13.209	– 22.220 *	13.064
Exclusion Variables								
Smoking control policies			– 0.320 **	0.155			0.124	0.153
Marriage			– 0.101 **	0.049			– 0.057	0.082
Children			– 0.011	0.017			– 0.002	0.013
Family size			– 0.019	0.013			– 0.021 *	0.012
(Interactions)								
Education			0.017	0.012			– 0.007	0.010
Manual worker			0.067	0.083			0.140	0.197
Self-control problem			0.007	0.057			– 0.043	0.062
Large city			0.121	0.095			– 0.037	0.058
City			0.108	0.074			0.086	0.061
athna ρ (ρ)	0.917 ***	0.149	(0.724)	(0.071)	1.690	1.721	(0.934)	(0.219)
ln σ (σ)	– 0.561 ***	0.057	(0.571)	(0.032)	– 0.422 **	0.206	(0.655)	(0.135)
Log likelihood	– 1191.677				– 397.87245			
Wald test (zero slope)	chi2(85) = 606.82***				chi2(31) = 2399.70***			
Wald test (ρ = 0)	chi2(1) = 37.76***				chi2(1) = 0.96			

Notes: (1) All standard errors in the male are heteroskedasticity robust standard errors.

(2) All standard errors in the female are clustering robust standard errors in prefectures.

(3) ***, **, and * represent statistically significant at 1, 5, and 10% levels, respectively.

(4) The equation for male includes the major industry dummies, latest appointments dummies, some macroeconomic factors, and local effects dummies.

(5) The equation for female includes the major industry dummies, latest appointments dummies, and some macroeconomic factors.