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TAIWAN

CIGARETTE SMOKING AND SELF-CONTROL

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Abstract

This paper empirically studies time inconsistent preferences in the context of cigarette smoking behavior. With hyperbolic discounting, an individual has time inconsistent preferences, which give rise to a lack of self-control, i.e., she may perpetually postpone the execution of a plan. This implies that a smoker who wants to quit has a demand for control devices, e.g., a smoking ban in public areas or a hike in cigarette excise taxes. This paper empirically tests this implication, using a sample that is based on survey data from Taiwan. The estimation results indicate that a smoker's intention to quit has a positive effect on the smoker's support for smoking bans and a cigarette excise tax increase. These results suggest that time inconsistent preferences are valid in the context of cigarette smoking behavior. This casts doubt on the validity of the assumption that individuals have time consistent preferences in Becker and Murphy's (1988) rational addiction model.

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1 Introduction

For several decades, cigarette smoking behavior has been studied by social scientists from a variety of disciplines. There are two aspects of the behavior which arouse researchers' interest. Firstly, cigarette smoking is harmful to one's health and society has to bear enormous costs arising from the productivity lost and from the medical expenses associated with smoking-induced diseases. An understanding of cigarette smoking behavior thus has important implications for intervention policies. Secondly, the behavior *per se* is interesting. It is puzzling why people develop and maintain a seemingly destructive habit even though most of them are aware of the harmful consequences and its addictive nature.

Due to their inability to explain smokers' behavior by the neoclassical framework and by assuming rationality, early researchers largely regarded cigarette smoking as myopic (e.g., Houthakker and Taylor, 1966, 1970). The assumption that smokers are myopic were maintained either implicitly or explicitly, e.g., Lewit and Coate (1982), Mullahy (1985), Baltagi and Levin (1986), and Jones (1989, 1994). These studies treat cigarette addiction as habit forming and model the reinforcement effect by allowing lagged consumption to have an impact on current consumption.

Later on, by allowing agents to recognize the dependence of the current consumption level on past consumption, some researchers were able to reconcile cigarette smoking with rationality. A notable example is the rational addiction model of Becker and Murphy (1988), where people have time consistent preferences, and are forward-looking. That is, in Becker and Murphy's (1988) model people are aware of the addictive nature of cigarette smoking and they choose to smoke simply because the *lifetime* benefits are greater than the costs.

Several hypotheses are derived in Becker and Murphy (1988). The most important one is that current consumption positively depends on future consumption. This implies that current consumption is inversely related to all prices (past, current and future), or equivalently current consumption is positively related to past and future consumption. Becker and Murphy's (1988) rational addiction model has given rise to a series of studies that empirically test the rationality of cigarette smoking and other addictive substances. For example, Chaloupka (1990, 1991) uses micro data and Perkurinen (1991), Keeler, Hu, Barnett and Manning (1993), Becker, Grossman and Murphy (1994) and Bardsley and Olekalns (1998) use time series data to study cigarette smoking behavior in the context of the Becker-Murphy (1988) model. Their empirical findings are consistent with Becker and Murphy's (1988) key prediction that current consumption depends on future consumption.

Recently, researchers have begun to question Becker and Murphy's rational addiction model on several grounds. First of all, the supporting evidence obtained by previous studies that test the implications of the Becker-Murphy model may not be conclusive in regard to the validity of all the assumptions underlying the rational addiction model. As pointed out by Gruber and Köszegi (2001), what is required to generate the positive relationship between current cigarette consumption and future consumption is the "forward looking" assumption only. That is, the time consistency assumption of the rational addiction model is not really tested. In modifying Becker and Murphy's (1988) rational addiction model by allowing an individual's preferences to be time inconsistent, Gruber and Köszegi (2001) are able to obtain the same relationship between current consumption and future consumption.[1] This means that while we can conclude from previous empirical evidence that individuals are forward looking, this evidence does not allow us to infer whether individuals' preferences are

[1]Gruber and Köszegi (2001) derive some empirical implications by assuming forward looking behavior but time inconsistent preferences. However, as they acknowledge, these implications are difficult to test empirically.

time consistent or not.[2]

Dissatisfaction with the ability of the rational addiction model of Becker and Murphy (1988) to explain individuals' struggles with harmful addictions has led some researchers to consider alternative approaches to analyzing individuals' decision-making processes. A plausible approach is to view individuals as having a lack of self-control, which arises from having time inconsistent preferences.

There is ample evidence suggesting that individuals have time inconsistent preferences and face self-control problems. Empirical and experimental findings in the economics and psychology literature (see, e.g., Thaler, 1981; Benzion, Rapoport, and Yagil, 1989; Angeletos, et al, 2001; and Laibson, Repetto, and Tobacman, 2004) suggest that individuals' discount rates for a fixed time interval are not constant, but decline when the time interval is further away from the present.

Moreover, Gruber and Mullainathan (2005) provide the first piece of evidence indicating that time inconsistent models are preferable to the rational addiction model. Based on individual-level cross-sectional data from Canada and the U.S., Gruber and Mullainathan (2005) find that smokers are happier after an increase in cigarette taxes. If smokers' happiness rises with cigarette taxes through a reduction in cigarette consumption, rational smokers can achieve the same increase in happiness by reducing cigarette consumption even in the absence of an increase in cigarette taxes. Thus, Gruber and Mullainathan's (2005) findings challenge the validity of the rational addiction model. By contrast, these findings suggest that smokers are better described as having time inconsistent preferences such that an increase in cigarette taxes will help solve their self-control problem.

This study empirically investigates the implications of time inconsistent prefer-

[2] It is shown by Auld and Grootendorst (2004) that testing the Becker-Murphy rational addiction model is likely to yield spurious supporting evidence when aggregate data are used.

ences in the context of cigarette smoking. When smokers have time inconsistent preferences which give rise to self-control problems, they have a demand for self-control devices if they want to quit. Accordingly, smokers who have an intention to quit smoking will support for public policies, which impose costs on smoking. From this implication, we obtain a testable hypothesis that a smoker's intention to quit smoking has a positive effect on her support for anti-smoking public policies, e.g., an increase in cigarette excise taxes, a ban on smoking in all public areas, and a ban on workplace smoking. We test this hypothesis based on individual survey data from Taiwan. Our hypothesis testing relies on an empirical model, which accounts for the possible endogeneity of a smoker's intention to quit.

The remainder of the paper proceeds as follows. We breifly illustrate the time inconsistent preferences associated with hyperbolic discounting and their implications in Section 2. The data source and variables used in the empirical investigation are described in Section 3. Our empirical model is illustrated in Section 4. The estimation results are reported and discussed in Section 5. A conclusion is given in Section 6.

2 Time Inconsistent Preferences

2.1 A Synopsis

Time inconsistent preferences are proposed by Strotz (1956), and futher developed by Phelps and Pollak (1968), Pollak (1968), Peleg and Yaari (1973), Yaari (1977), and Goldman (1979, 1980). Motivated by findings from laboratory and field studies indicating that individuals are time inconsistent (e.g., Prelec and Loewenstein, 1991; and Ainslie, 1992), there has been a recent revival in interest in time inconsistent preferences in the economic literature.

Notable recent theoretical studies of addiction based on models of time inconsistent preferences include O'Donoghue and Rabin (1999b) Gruber and Köszegi (2001), O'Donoghue and Rabin (2002), and Gruber and Köszegi (2004). These papers consider both the cases when individuals are aware of their own self-control problems and when they do not know their self-control problems. The focus of O'Donoghue and Rabin (1999b) and O'Donoghue and Rabin (2002) is on the effect of an individual's awareness of her own self-control problems. They find that under realistic environments, an individual's awareness of her self-control problems mitigates the over-consumption of an addictive product.

The purpose of Gruber and Köszegi (2001) is to show that a time inconsistent model, where individuals are forward-looking but have time inconsistent preferences, is able to generate the Becker and Murphy (1988) prediction that current consumption depends positively on future consumption. They also show analytically that, due to the existence of "internality," there is room for government intervention, e.g., a tax hike could be welfare improving. By adopting a time inconsistent formulation, Gruber and Köszegi (2004) analyze the implications of an increase in cigarette excise taxes. Cigarette excise taxes, serving as a self-control function, may benefit a low income smoker under the assumption that her demand for cigarettes is more price sensitive.

Time inconsistent preferences are characterized by discount rates which are much greater in the short-run than in the long-run, as exhibited by hyperbolic discount functions, i.e.,

$$U_t = \delta^t u(c_t) + \beta \sum_{\tau=t+1}^{T} \delta^\tau u(c_\tau), \tag{1}$$

where U_t is an individual's time t lifetime utility, c_t is the consumption level at time t, $u(c_t)$ is single period utility at time t, and δ and β are discount factors, with $1 \geq \{\delta, \beta\} > 0$. Formulation (1), which has been commonly adopted in the recent literature, is first developed by Phelps and Pollak (1968). Under this formulation the discount rate between the current period and the next period is $\frac{1-\delta}{\delta}$, while that between any two consecutive periods beyond the current period is $\frac{1-\beta\delta}{\beta\delta}$, with $\frac{1-\delta}{\delta} < \frac{1-\beta\delta}{\beta\delta}$.[3] Thus, under formulation (1), from the perspective of the current period, the discount rate between the current period and the next period is higher than that between any two consecutive periods in the future. However, when the next period arrives, the discount rate between that period and the following period is higher than that between any two consecutive periods thereafter. This shift in the discount rate between two consecutive periods leads an individual's optimal choice in the current period to be different from that chosen in the previous period, and the self-control problem arises.

2.2 A Simple Model

To demonstrate the role of self-control devices we consider a simple theoretical model of decision making by a smoker. Our model is adapted from O'Donoghue and Rabin (1999b, 2000), which is simplied by Peck and Laux (2004). In the model an infinitively-lived smoker faces two choices, i.e., to continue smoking or to quit. The two choices yield different paths of lifetime utilities, i.e.,

$$\{\mathsf{S},\mathsf{S},\mathsf{S},...\}, \text{ if she continues smoking; and} \tag{2}$$

$$\{\mathsf{Q},\mathsf{N},\mathsf{N},...\}, \text{ if she quits smoking.} \tag{3}$$

where S, Q, and N are per-period utility, with $\mathsf{Q} < \mathsf{S} < \mathsf{N}$. We assume that the utility in the period when she quits (i.e., Q) is less than that if she smokes in that period (i.e., S). By assuming $\mathsf{Q} < \mathsf{S}$, we want to capture the disutility from quitting. The higher per period utility associated with abstinence (denoted by N, i.e., $\mathsf{S} < \mathsf{N}$) is due to the fact

[3] For $\beta = 1$ we have the conventional exponential discounting formulation (as adopted by Becker and Murphy, 1988).

that smoking is harmful. She quits in the current period if

$$\mathsf{Q} + \beta \sum_{t=1}^{\infty} \delta^t \mathsf{N} > \mathsf{S} + \beta \sum_{t=1}^{\infty} \delta^t \mathsf{S},$$

$$\text{i.e.,} \quad \mathsf{S} - \mathsf{Q} < \frac{\beta\delta}{1-\delta}(\mathsf{N} - \mathsf{S}). \tag{4}$$

Thus, the cost of quitting (i.e., $\mathsf{S} - \mathsf{Q}$) must be smaller than the lifetime gain from not smoking $\left(\text{i.e., } \frac{\beta\delta}{1-\delta}(\mathsf{N} - \mathsf{S})\right)$ in order for her to quit.

Instead of quitting in the current period, she may consider quitting in the next period. From the perspective of the current period, she plans to quit in the next period if

$$\beta\mathsf{Q} + \beta \sum_{t=1}^{\infty} \delta^t \mathsf{N} > \beta\mathsf{S} + \beta \sum_{t=1}^{\infty} \delta^t \mathsf{S}$$

$$\text{i.e.,} \quad \mathsf{S} - \mathsf{Q} < \frac{\delta}{1-\delta}(\mathsf{N} - \mathsf{S}). \tag{5}$$

Since $\beta \leq 1$, it is more likely for her to plan to quit in the next period than to actually quit in the current period, as $\frac{\delta}{1-\delta}(\mathsf{N}-\mathsf{S})$ in inequality (5) would be greater than $\frac{\beta\delta}{1-\delta}(\mathsf{N}-\mathsf{S})$ in inequality (4).

If the following inequality holds, the individual is a perpetual procrastinator.

$$\frac{\beta\delta}{1-\delta}(\mathsf{N} - \mathsf{S}) < \mathsf{S} - \mathsf{Q} < \frac{\delta}{1-\delta}(\mathsf{N} - \mathsf{S}), \tag{6}$$

This is because, when (6) holds she will not quit in the current period, but will plan to quit in the next. However, when the next period arrives, she will again postpone her plan for one more period. This postponing will continue for ever and she will never execute her plan to quit.

An implication of time inconsistent preferences is that an individual, who realizes her self-control problems, has a demand for commitment devices. To see this, we go back to our example. If a smoker decides to quit in the next period (i.e., inequality (6) holds) she may impose on herself a cost C, which is to be paid if she smokes in the next period. To be effective, C must be large enough such that when the next period comes the lifetime utility associated with quitting is greater than the costs, i.e.,

$$S - Q - C < \frac{\beta\delta}{1-\delta}(N - S). \tag{7}$$

According to (7), for the plan to quit to be executable,

$$C > S - Q - \frac{\beta\delta}{1-\delta}(N - S). \tag{8}$$

One example of such commitment devices is betting with a friend that one would succeed in quitting in the next period.[4] The effectiveness of self-control strategies to achieve smoking cessation is supported by experimental evidence obtained in the psychology literature.[5]

3 Data and Variables

The empirical work of our study is based on survey data obtained from the Panel Study of Family Dynamics (PSFD). The aim of the PSFD is to understand the structure and evolution of the Chinese family in Taiwan, as well as the mode of interaction of its members.[6]

The PSFD comprises multi-year panel surveys starting from 1999. The survey adopts a three-stage random sampling procedure. In the first stage, a number of geographical areas (cities or towns, which are equivalent to "standard metropolitan statistical areas" in the U.S.) are randomly selected. The probability of a geographical area being selected is proportional to its population size. In the second stage, smaller administrative districts (communities, called "li" in Taiwan, and villages) are randomly

[4]See Prochaska, et al. (1982).

[5]See Murray and Hobbs (1981) and Grabowski and Hall (1985).

[6]The data, questionnaire, and details of the survey are available at http://psfd.sinica.edu.tw/index_e.htm.

drawn from the selected geographical areas. Again, the probability of a district being selected is proportional to its population size. In the third stage, individuals are randomly drawn from the selected administrative districts.[7]

The PSFD sample mainly consists of three cohorts (age groups), i.e., individuals born in 1934–1953, 1954–1963, and 1964–1978.[8] The 1954–1963 cohort was first interviewed in 1999. In February 1999, a nationally representative, random sample of individuals aged 36–45 (born 1954–1963) was drawn and interviewed. The targeted sample size was 1,000, and 995 interviews were completed. The interviewing of the 1944–1953 and 1943–1934 cohorts started in 2,000. In February 2000, in addition to interviewing the 1954–1963 cohort, a nationally-representative random sample of individuals born in 1944–1953 and 1943–1934 was drawn and interviewed. These individuals are interviewed in the spring every year. With a targeted number of respondents of 2,000, the RI2000 survey successfully interviewed 1,959 individuals.

The interviewing of sampled individuals in the last cohort, i.e., those born in 1964–1978, started in 2003. The sampling of respondents in the 1964–1978 cohort also followed the three-stage random sampling procedure mentioned above. The targeted number of respondents was 1,300, and only 1,230 interviews were actually completed.

In the 2004 PSFD questionnaire, there was a module on cigarette smoking behavior. Due to the fact that a smoker's demand for self-control is difficult to measure, we use her supportiveness for some smoking-related public policies as proxies. Information on a smoker's supportiveness for a public policy is collected by a set of questions:

[7]Given Taiwan's population size of twenty-three million, our sample of around 3,000 is fairly representative. The representativeness of the PSFD sample is comparable to that of the University of Michigan's Panel Study of Income Dynamics (PSID). For the year 2001, there were 7,406 families in the PSID sample, which was considered to be representative of the U.S. population of 284.8 million.

[8]Beginning in 2000, a sample of respondents, which consisted of children aged 16–26, were interviewed.

Do you support for the following public policies:
(A) An increase in cigarette excise taxes.
(B) Banning cigarette smoking in all public areas;
(C) Banning cigarette smoking in work places;

Possible answers to these questions are:
(5) Strongly supportive;
(4) Somewhat supportive;
(3) Neither supportive, nor against;
(2) Somewhat against;
(1) Strongly against

The variables which are constructed based on information collected from these three questions are named, respectively, `CigTax`, `BanPublic`, and `BanWork`, which take values 1–5.

The implementation of these public policies will increase the costs of smoking. Thus, a time consistent (i.e., "rational") smoker, who does not have self-control problems, will not support for any of these policies regardless of whether or not she wants to quit smoking. This is because a time consistent smoker is able to quit without any difficulty once she finds that abstinence from smoking brings her greater lifetime utility. Information on the repondents' intention to quit (denoted by `Quit`) comes from a question asking all smokers whether they have any intention to quit smoking in the future or not.

Since we are mainly interested in the relationship between a smoker's intention to quit cigarette smoking and her demand for self-control devices, our empirical analysis is confined to current smokers. After deleting observations with missing values for the variables that we use in the empirical analysis, the 2004 PSFD data contains 2,868 respondents, among which 23.30% were current smokers. Thus, our sample consists of 669 current smokers.

All variables used in our empirical analysis are listed and defined in Table 1, and descriptive statistics of these variables are displayed in Table 2. The frequency distributions of CigTax, BanPublic, and BanWork are displayed in Table 3. In order to have an understanding of how CigTax, BanPublic, and BanWork are related to an individual's smoking status and the intention to quit, in addition to reporting descriptive statistics pertaining to our sample of current smokers, we also report those pertaining to the 2004 PSFD full sample (which consists of both smokers and non-smokers) in Tables 2 and 3.

According to columns 2–3 of Table 2, the means of CigTax, BanPublic, and BanWork for non-smokers are 3.78, 4.49, and 4.42, while the corresponding sample means for smokers are 2.28, 4.00, and 3.47. A comparison of the sample means of these three variables for non-smokers and smokers shows that non-smokers are more supportive for a hike in cigarette excise taxes, a ban on cigarette smoking in all public areas, and a ban on smoking in the work place. This is reasonable because a hike in cigarette excise taxes will increase the monetary cost of smoking, and bans on cigarette smoking will make it more inconvenient to smoke and smokers may have to refrain from smoking. The sample means of CigTax, BanPublic, and BanWork pertaining to smokers who intend to quit are 2.58, 4.16, 3.69, as reported in the third column of Table 2. They are higher than the corresponding sample means pertaining to smokers who do not intend to quit (i.e., 2.01, 3.86, and 3.27, as reported in the fourth column of Table 2). This is consistent with our conjecture that smokers who intend to quit have a demand for self-control devices. However, smokers who intend to quit are less supportive for the three smoking-related public policies than non-smokers. supportive than non-smokers.

The frequency distributions of CigTax, BanPublic and BanWork in Table 3 show that, of all anti-smoking public policies, the respondents' (smokers or non-smokers alike) supported for a cigarette excise tax hike the least. Moreover, when compared to other public policies, the smokers' disapproval of a cigarette excise tax increase was particularly strong. There were 2.84% and 10.18% of smokers, respectively, who were strongly against and somewhat against a public area smoking ban; and 5.69% and 22.75% of smokers, respectively, who were strongly against and somewhat against a workplace smoking ban. By contrast, 39.07% and 24.70% of smokers, respectively, were strongly against and somewhat against an increase in cigarette excise taxes. This pattern may reflect the general public's dislike of taxation in Taiwan.

By comparing the frequency distributions of smokers with and without an intention to quit, we see that those who had an intention to quit did have a higher likelihood being strongly supportive or somewhat supportive for an anti-smoking public policy.

4 Empirical Model

The objective of the empirical analysis is to examine the effect of a smoker's intention to quit on her demand for self-control devices, which is proxied by an her attitude toward the three anti-smoking public policies (i.e., a hike in cigarette excise taxes, and public area and workplace smoking bans). In our empirical specification, the strength of individual i's support for policy k, denoted by Π^*, is a function of her socio-economic characteristics, denoted by $\boldsymbol{X}_i$ and her intention to quit, denoted by Q_i, which corresponds to the variable `Quit` in our data. That is,

$$\Pi^*_k = \gamma_k Q_i + \boldsymbol{\beta}'_k \boldsymbol{X}_i + \epsilon_{ki};\ k = 1,2,3; \tag{9}$$

where ϵ_i is a residual term, which picks up omitted (unobserved) variables affecting an individual's attitude toward smoking-related public policies.

If people have a lack of self-control, as implied by hyperbolic discounting, a smoker who intends to quit smoking will have a demand for self-control devices. This implies that if smoker i intends to quit smoking, i.e., $Q_i = 1$, her support for all three anti-smoking public policies will be stronger, such that γ is positive. The null and alternative hypotheses that we are going to test are as follows:

$$\begin{aligned} &\mathrm{H}_0: \ \gamma_k = 0 \ \text{(as implied by time consistent preferences)},\\ &\mathrm{H}_1: \ \gamma_k > 0 \ \text{(as implied by time inconsistent preferences)}. \end{aligned}$$

In what follows, we will illustrate our empirical model in more detail. Since information on an individual's support for a certain public policy is solicited on a five-point scale, we do not observe Π_k^*. What we observe is a variable Π_k, which takes five possible values, i.e., 1–5.[9]

We assume the following relationship between Π_k^* and Π_k:

$$\Pi_k = j \ \text{ if } \ \alpha_{kj-1} < \Pi_k^* \leq \alpha_{kj}; \ \ j = 1, 2, \ldots, 5; \tag{10}$$

where α_j is a parameter to be estimated, and $\{\alpha_0, \alpha_5\}$ are set to $\{-\infty, \infty\}$ for normalization. Under specification (10) we have an ordered choice model. We obtain an ordered probit model for a smoker's supportiveness for a public policy by further assuming that ϵ_{ki} is standard normally distributed.

As an explanatory variable of a smoker's supportiveness for a public policy, $\boldsymbol{Q}_i$ is likely to be endogenous. To account for this, we set up an empirical model for $\boldsymbol{Q}_i$ and allow a cross-equation correlation between the model for $\boldsymbol{Q}_i$ and that for Π_k^*. Since $\boldsymbol{Q}_i$ is binary, taking the value 1 or 0, we model it by means of a probit model, i.e.,

$$\boldsymbol{Q}_i = \begin{cases} 1, & \boldsymbol{Q}_i^* > 0 \\ 0, & \text{otherwise}; \end{cases} \tag{11}$$

$$\boldsymbol{Q}^* = \boldsymbol{\delta}' \boldsymbol{Z}_i + u_i, \tag{12}$$

where $\boldsymbol{Q}^*$ is a latent variable, $\boldsymbol{Z}_i$ is a vector of individual characteristics, consisting of $\{\boldsymbol{X}_i, \boldsymbol{Z}_{1i}\}$, $\boldsymbol{\delta}$ is a vector of parameters to be estimated, and u_i is a standard normally distributed residual. If the residuals ϵ_{ki} and u_i are correlated, $\boldsymbol{Q}_i$ in regression model (9) is endogenous, and estimating (9) without accounting for this endogeneity

[9] Π_k corresponds to the three variables `CigTax`, `BanPublic` and `BanWork` in our data.

will yield biased estimates of $\{\gamma_k, \boldsymbol{\beta}_k\}$. Thus, we allow ϵ_{ki} and u_i to be correlated, i.e., $\text{corr}(\epsilon_{ki}, u_i) = \rho_k \neq 0$.[10]

In general, endogeneity arises from the presence of unobserved variables affecting both the dependent variable of interest and the explanatory variables. In the present case, endogeneity is potentially serious because the utilities associated with the various smoking-related statuses (denoted by S, Q and N in our simple model in Section 2.2) are not observable and they are likely to be the source of endogeneity in model (9). Even though socio-economic characteristics are used to explain both $\boldsymbol{Q}_i^*$ and Π_k^*, these utilities may not be totally captured by an individual's observed characteristics. The unexplained utilities may enter the residual terms ϵ_{ki} and u_i. The presence of common unobserved variables in both ϵ_{ki} and u_i leads to correlation between the two variables.

To make a conjecture on the sign of the correlation between ϵ_{ki} and u_i, we examine equations (4) and (8) in Section 2.2. Equations (4) and (8), respectively, suggest that while both the decision to quit and the size of the self-committed cost C depend on the utilities associated with the three smoking statuses (i.e., Q, S, and N), they depend on Q, S, and N in opposite directions. As is clear from equation (4), the likelihood of an individual quitting increases with the benefit from quitting (i.e., $\mathsf{N}-\mathsf{S}$) and decreases with the cost of quitting (i.e., $\mathsf{S}-\mathsf{Q}$), i.e., it is positively related to N and Q, and negatively to S. Conversely, according to equation (8), the size of the self-committed cost C decreases with the benefit of quitting and increases with the costs of quitting, i.e., it is negatively related to N and Q, and positively to S. In our empirical model, the variable

[10] A more effective way to control for endogeneity would be to use longitudinal data so that we can examine how a smoker's supportiveness for an anti-smoking public policy changes when her intention to quit changes. This control for endogeneity arises from *time invariant* heterogeneity, which affects both variables. However, even though the PSFD survey is a longitudinal one, the health module is only included in the 2004 questionnaire so that information on some key variables, e.g., the intention to quit smoking, is only available from the 2004 survey.

Π^*_{it} is a proxy for the self-committed cost C so that it is also negatively related to N and Q, and positively to S. Given the impossibility of perfectly capturing the utilities Q, S, and N using the individuals' socio-economic characteristics in our regression models, the uncaptured utilities will be absorbed by the error terms ϵ_{ki} and u_i, which are related to Q, S, and N in opposite directions. This implies that the correlation between ϵ_{ki} and u_i is negative.

The estimation of the simultaneous equations system, which consists of regression equations (9) and (12), is performed by means of the maximum likelihood method. The log-likelihood function for $\Pi_k = j$ is as follows:

$$\begin{aligned}\mathscr{L}_{ji} \quad &= \quad \boldsymbol{Q}_i \times \log \int_{\alpha_{kj-1}-\boldsymbol{\beta}'_k \boldsymbol{X}_i}^{\alpha_{kj}-\boldsymbol{\beta}'_k \boldsymbol{X}_i} \int_{-\boldsymbol{\delta}'\boldsymbol{Z}_i}^{\infty} f(\epsilon_{ki}, u_i; \rho_k) \mathrm{d}\epsilon_{ki} \mathrm{d}u_i \\ &+(1-\boldsymbol{Q}_i) \times \log \int_{\alpha_{kj-1}-\boldsymbol{\beta}'_k \boldsymbol{X}_i}^{\alpha_{jk}-\boldsymbol{\beta}'_k \boldsymbol{X}_i} \int_{-\infty}^{\boldsymbol{\delta}'\boldsymbol{Z}_i} f(\epsilon_{ki}, u_i; \rho_k) \mathrm{d}\epsilon_{ki} \mathrm{d}u_i. \qquad (13)\end{aligned}$$

The estimation of the parameters is obtained by maximizing the following log-likelihood function,

$$\mathscr{L} = \sum_{i=1}^{N} \sum_{\Pi_k = j} \mathscr{L}_{1ji}; \quad j = 1, \ldots 5; \qquad (14)$$

where N is the sample size.

For identification purposes we impose an exclusion restriction, i.e., $\boldsymbol{Z}_{1i}$, are included in (12), i.e., the model for `Quit`, but are excluded from (9), which pertains to the supportiveness for a public policy. In other words, the variables $\boldsymbol{Z}_{1i}$ are the instruments used for identification. In the current study, the vector $\boldsymbol{Z}_{1i}$ consists of two variables, namely `WControl` (i.e., pertaining to one's weight control activities) and `HeardRisk` (i.e., whether one has heard of the saying that cigarette smoking is seriously harmful to one's health).

By excluding these two variables from (9), we assume that they have direct effects on an individual's decision to quit only, but not on her supportiveness for an anti-smoking public policy. More specifically, we impose the assumptions that $\mathrm{cov}(\boldsymbol{Z}_{1i}, \epsilon_{ki}) =$

0 and $\text{cov}(\boldsymbol{Z}_{1i}, Q_i|\boldsymbol{X}_i) \neq 0$. The statistical testing of these two assumptions, to be explained in detail below, will be conducted. Intuitively, these assumptions are likely to be valid. Having heard that cigarette smoking is associated with harmful health effects (i.e., `HeardRisk=1`) is likely to prompt her to plan to quit. Having attempted to lose weight, however, is likely to discourage a smoker from planning to quit because it is well known that a cessation of smoking is often followed by a weight gain. These two variables are unlikely to be directly related to whether or not a smoker supports for an anti-smoking public policy.

It is noted that all exogenous variables (i.e., $\{\boldsymbol{X}_i, \boldsymbol{Z}_{1i}\}$) are included in model (12), which pertains to `Quit`, as explanatory variables. Because of this, the regression equation for `Quit` is specified as a reduced form equation. In this way, we do not need to consider a structural specification in modeling `Quit`. This minimizes the risk of misspecification.

4.1 Weak Instruments Test

Since the reliability of our results hinges critically on the validity of our instruments $\boldsymbol{Z}_{1i}$, it is important for us to make sure that $\boldsymbol{Z}_{1i}$ are valid. In order to test the validity of the instruments $\boldsymbol{Z}_{1i}$, a weak instruments test and a test for the exclusion restriction are performed. Our weak instruments test involves estimating a univariate probit model for (12) and testing for the explanatory power of $\boldsymbol{Z}_{1i}$ by means of a likelihood ratio test. The likelihood ratio test statistic, denoted by τ_χ, is chi-square distributed with K (i.e., the number of instruments) degrees of freedom.

It is noted that Staiger and Stock (1997) recommend that instruments be weak when the F-statistic is below the critical value of 10. However, we cannot perform the conventional F-test based on (12) since it is a nonlinear model. The conventional F-test, involving the computation of the sum of squared residuals for the restricted and unrestricted models, can only be computed for linear models, where the dependent variable is linearly related to the error term. Yet, as the denominator degrees of freedom of an F-distributed variable approach infinity, the random variable, if normalized by its numerator degrees of freedom, is chi-square distributed.[11] Thus, we can obtain an F-statistic τ_F from our likelihood ratio test statistic as follows:

$$\tau_F = \tau_\chi / K \quad \sim F(K, \infty),$$

which has degrees of freedom $\{K, \infty\}$. With this F-statistic we are able to use Staiger and Stock's (1997) criterion to determine whether our instruments are weak or not.[12]

4.2 Overidentification Restriction Test

We test the validity of the exclusion restriction, i.e., $\text{cov}(\boldsymbol{Z}_{1i}, \epsilon_{ki}) = 0$, by estimating an unrestricted version of our simultaneous equations model (13), where both $\boldsymbol{Z}_{1i}$ and $\boldsymbol{X}_i$ are used as regressors to explain the supportiveness for a public policy, i.e.,

$$\Pi_k^* = \gamma_k \boldsymbol{Q}_i + \boldsymbol{\beta}_k' \boldsymbol{X}_i + \boldsymbol{\lambda}_k' \boldsymbol{Z}_{1i} + v_{ki};\ k = 1, 2, 3. \tag{15}$$

A likelihood ratio test is conducted to test the null hypothesis $\text{H}_0 : \boldsymbol{\lambda} = 0$, i.e., the exclusion restrictions are valid. It is noted that in (15) no exclusion restriction is imposed. A simultaneous equations probit model can be estimated without imposing an exclusion restriction because the binary endogenous regressor is a nonlinear function of its explanatory variables. See Wilde (2000) for a proof. Our test is similar to Rashad and Kaestner's (2004).

[11]Denote an F-distributed random variable by f, with $f = \frac{x_1/n_1}{x_2/n_2}$, where both x_1 and x_2 are chi-square distributed random variables with degrees of freedom n_1 and n_2. As n_2 approaches infinity, x_2 approaches its expected value of n_2. This implies that f/n_1 is asymptotically chi-square distributed with n_1 degrees of freedom as n_2 tends to infinity.

[12]As a cross-check, we estimate (12) with a linear probability model and compute the F-statistic based on the results.

5 Results

Our estimation results are reported in Tables 4–9. Before examining whether our conjecture concerning self-control is supported by the estimation results, we first examine the specification of our empirical model. The likelihood ratio test for the explanatory power of our instruments `WControl` and `HeardRisk` yields a χ^2-statistic of 39.1985, which is asymptotically equivalent to an F-statistic of 19.5993. This F-statistic is larger than the Staiger-Stock (1997) critical value of 10, indicating that our instruments are not weak with respect to `Quit`.[13]

In addition, we have also performed tests for the validity of the exclusion restrictions, i.e., overidentification restrictions. The likelihood ratio tests of the null hypothesis that "$\boldsymbol{Z}_{1i}$ are not correlated with an individual's supportiveness for a smoking-related public policy" yield test statistics of 3.4428, 1.4412, and 0.9456, respectively, for the models pertaining to `CigTax`, `BanPublic`, and `BanWork`. With p-values of 0.1788, 0.4864, and 0.6233, respectively, we accept the null hypothesis for all three public policies. See the bottom of Tables 4–6.

Moreover, we have conducted Hausman tests, which compare the changes in `Quit`'s coefficients with and without allowing the variable to be endogenous, to examine the endogeneity of `Quit`. In the case of the model pertaining to `CigTax`, the test statistic, having a p-value of 0.1038, is almost significant at the 10% level. The Hausman test indicates, albeit short of overwhelmingly, that `Quit` is likely to be endogenous. For models pertaining to `BanPublic` and `BanWork`, the Hausman test statistics, with p-values of 0.0167 and 0.0168, respectively, are significant at conventional levels. This indicates that `Quit` is endogenous in the two models. The Hausman test statistics are

[13] We have also run an OLS regression of `Quit` on $\{\boldsymbol{X}_i, \boldsymbol{Z}_{1i}\}$ (i.e., a linear probability model is employed) and conducted an F-test to test for the explanatory power of $\boldsymbol{Z}_{1i}$. This yields an F-statistic of 19.59, which is remarkably consistent with our probit-based likelihood ratio test.

reported in the bottom at Tables 4, 6, and 8.

Table 4 pertains to estimation results of the effects of an individual's intention to quit on her support for a cigarette excise tax hike. The estimate of the correlation coefficient between ϵ_{1i} and u_i, denoted by ρ_k in Table 4, is statistically significant. The sign of the coefficient estimate of ρ_k coincides with our conjecture concerning the correlation between the error terms of the models for `CigTax` and `Quit` in Section 4. We conjecture in Section 4 that due to the impossibility of perfectly capturing utilities associated with different smoking statuses by means of demographic variables in the empirical model, the error terms pertaining to `CigTax` and `Quit` will absorb these uncaptured utilities. The negative correlation between the two error terms is due to the fact that the utilities associated with different smoking statuses are related to the quit decision and the strength of self-control in opposite directions. Our finding of a negative correlation coefficient reinforces the plausibility of the hyperbolic discounting framework in describing smoking behavior.

The results in the first column of Table 4 show that the coefficient estimate of `Quit` is positive and statistically signficant. This positive coefficient is supportive of our hypothesis that those who intend to quit smoking are more likely to support for a hike in cigarette excise taxes. The positive marginal effects of `Quit` on `CigTax=5` and `CigTax=4` (the highest level of support for a cigarette excise tax hike), with numerical values of 0.1220 and 0.1700, respectively, are very substantial. Moreover, the marginal effect of `Quit` on `CigTax=1` (i.e., strongly disapprove of an increase in cigarette taxes) of -0.3387, testifies to the strong impact of the individual's intention to quit on her supportiveness for a hike in cigarette taxes. Actually the magnitudes of these marginal effects of `Quit` are much larger than those pertaining to all other variables. Thus, the effects of `Quit` are numerically very important in regard to a smoker's supportiveness for a cigarette excise tax hike, and it is the most important variable explaining a smoker's tax hike supportiveness.

A smoker's age (denoted by `Age`), health status (denoted by `Health`), and the presence of other smokers at home or at work (denoted by `SecondHand`) are important determinants of her support for an increase in cigarette excise taxes. According to the estimation results in the first column of Table 4, an older smoker or a healthier smoker is more supportive for a tax hike. If there are other people who smoke in the smoker's home or workplace, she is also more likely to support for a tax hike.

A smoker's other demographic variables such as years of education (denoted by `Education`), gender (denoted by `Sex`), being married (denoted by `Married`), income level (denoted by `Income`), and number of children (denoted by `Child`) are not able to explain her supportiveness for a hike in cigarette excise taxes.

According to the second column of Table 4, a smoker's years of education, health status, having heard of the saying that cigarette smoking is seriously harmful to a person's health (denoted by `HeardRisk`), and engagement in a program to lose weight (denoted by `WControl`) are able to explain her intention to quit smoking. A smoker, who has more education, is in poor health, has heard of the saying that smoking is seriously harmful to a person's health, or engages in a program to lose weight, is more likely to have an intention to quit smoking.

Other factors, such as an individual's age, gender, marital status, income level, number of children, and the presence of other smokers at the home/workplace, do not have a statistically significant effect on a smoker's intention to quit smoking.

The results pertaining to a smoker's supportiveness for a smoking ban in public areas is presented in Table 6. The coefficient of `Quit` in the first column of the table is numerically and statistically significant. This shows that a smoker's intention to quit has a positive effect on her supportiveness for a public area smoking ban. This, again, is supportive for our hypothesis that a smoker's intention to quit leads her to demand a self-control device, as implied by time inconsistent preferences. The marginal effects of `Quit` (as displayed in Table 7) are very large. Having an intention to quit increases a smoker's probability of strongly supporting for a public area smoking ban (i.e., `BanPublic=5`) by 0.3450. This marginal effect on strongly supporting for such a smoking ban is the largest among all explanatory variables.

Another piece of evidence supporting the validity of our hypothesis that smokers have self-control problems is the negative coefficient estimate of the correlation between the error terms pertaining to `BanPublic` and `Quit` (denoted by ρ_k in Table 6). Our estimate of this correlation coefficient is statistically and numerically significant. As conjectured in Section 4 according to our simple model with hyperbolic discounting, the correlation coefficient of the two error terms should be negative. This negative coefficient estimate also explains the fact that if cross-equation correlation is not allowed, the coefficient for `Quit` is seriously downward-biased (see the third column of Table 6).

The qualitative pattern of the estimation results pertaining to other explanatory variables is similar to that associated with `CigTax`. The exception is that the positive effect of a smoker's age is statistically significant in explaining `CigTax`, but it becomes statistically insignificant in explaining `BanPublic`.

The estimation results pertaining to a smoker's supportiveness for a smoking ban in workplaces is presented in Table 8. Similar to the results corresponding to `CigTax` and `BanPublic`, with the coefficient of `Quit` being positive and statistically significant in explaining `BanWork`, we find that a smoker's intention to quit is able to enhance her supportiveness for a workplace smoking ban. As reported in Table 9, having an intention to quit increases the probabilities of a smoker strongly supporting and moderately supporting (i.e., `BanWork=5` and `BanWork=4`, respectively) for a workplace smoking ban by 0.2980 and 0.0768, respectively, and decreases the probabilities of her strongly disapproving and somewhat disapproving (i.e., BanWork=1 and BanWork=2, respectively) such a policy by 0.1227 and 0.2105, respectively. These marginal effects are larger than those pertaining to all other variables.

The correlation coefficients between the error terms of BanWork and Quit are negative and statistically significant, supporting our a priori conjecture. Furthermore, a comparison of Quit's estimated coefficients with and without allowing for such a correlation coefficient suggests that, without allowing for ρ_k, the coefficient estimate of Quit is seriously biased.

Qualitatively, the pattern of findings concerning the other explanatory variables is similar to that corresponding to CigTax. A smoker's age and the presence of other smokers at home or at work have a negative effect on her supportiveness for a workplace smoking ban. All other explanatory variables are statistically insignificant in explaining a smoker's supportiveness for a workplace smoking ban.

To summarize, our empirical results indicate that smokers, who have a plan to quit in the future, are more likely to support for anti-smoking public policies, suggesting that smokers are likely to have time inconsistent preferences and to discount the future hyperbolically.[14] With time inconsistent preferences, a smoker is likely to postpone any plan to quit. Thus, if she plans to quit, due to her time inconsistent preferences, her plan will never be executed. In realizing her self-control problem, such a smoker will have a demand for self-control devices in order to circumvent this problem. Since an anti-smoking public policy helps a smoker to execute her plan to quit by raising the costs of smoking, a smoker with time inconsistent preferences will support for such a public policy if she plans to quit smoking.

[14] We have also obtained empirical results when a binary public policy supportiveness variable is used (where a value of 1 is coded for "strongly supportive" or "somewhat supportive" and 0 is coded for other responses). The results thus obtained are similar to those we report in the paper. These additional results, which are not reported in the paper, are available upon request.

6 Conclusion

If individuals have time inconsistent preferences, as created by hyperbolic discounting, they have self-control problems. An implication of time inconsistent preferences in the context of cigarette smoking is that smokers who want to quit will have a demand for self-control devices in order to avoid perpetual procrastination.

This study tests a hypothesis derived from this implication. According to this hypothesis a smoker's intention to quit smoking has a positive effect on her support for public policies, which impose costs on smokers (i.e., an increase in cigarette excise taxes, a ban on smoking in all public areas, and a ban on workplace smoking). We test this hypothesis based on individual survey data from Taiwan. We carry out our hypothesis testing by means of an empirical model, which accounts for the possible endogeneity of a smoker's intention to quit. The endogeneity of the quit intention is suggested by our simple theoretical model.

We obtain empirical results that are strongly supportive for our hypothesis. The estimation results show that a smoker's intention to quit smoking does have a positive effect on her supportiveness for an anti-smoking public policy, and this effect is numerically very significant. This finding suggests that smokers do have self-control problems such that they have a demand for self-control devices when they want to quit smoking. In addition, our finding also casts doubt on the validity of Becker and Murphy's (1988) rational addiction model where individuals' preferences are assumed to be time consistent. Under the rational addiction model a current smoker will not support for any anti-smoking public policy, regardless of whether she intends to quit or not, and she may support for such public policies only when she has quit.

Moreover, we find that the quit intention is endogenous as an explanatory variable in the case of a smoker's supportiveness for an anti-smoking policy. The pattern of endogeneity coincides with that predicted by our theoretical model. This lends additional support to the validity of time inconsistent preferences in the context of cigarette smoking.

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Table 1: Variable Definition

CigTax	Whether supportive for or against an increase in cigarette excise tax or not. Possible answers are: 1 (Strongly against), 2 (Somewhat against), 3 (Neither supportive, nor Against), 4 (Somewhat supportive), and 5 (strongly supportive).
BanPublic	Whether supportive for or against a ban on smoking inall public areas or not. Possible answers are: 1 (Strongly against), 2 (Somewhat against), 3 (Neither supportive, nor Against), 4 (Somewhat supportive), and 5 (strongly supportive).
BanWork	Whether supportive for or against a ban on smoking in the workplace or not. Possible answers are: 1 (Strongly against), 2 (Somewhat against), 3 (Neither supportive, nor Against), 4 (Somewhat supportive), and 5 (strongly supportive).
Quit	Whether intend to quit in the future or not. Defined as Quit=1 if yes, and Quit=0 if no.
Education	Years of schooling.
Age	Age.
Sex	Gender of respondent. Defined as Sex=1 if male, and Sex=0 if female.
Married	Whether married. Defined as Married=1 if married, Married=0 if single, divorced, or widowed.
Health	Self evaluated health status. Possible answers are Health=1 if very good, Health=2 if good, Health=3 if just ok, Health=4 if not very good, Health=5 if very poor.
Income	Average monthly labor income in the previous year divided by 100,000.
Child	Number of children.
SecondHand	Whether or not there is secondhand smoke at home or in workplace; SecondHand=1 if yes, and SecondHand=0 if no.
HeardRisk	Whether one has heard of the saying that cigarette smoking has serious harmful effects on one's health. Defined as HeardRisk=1 if yes, and HeardRisk=0 if no.
WControl	Weight control programs. Defined as WControl=1 if the respondent attempts to lose a lot of weight, WControl=2 if the respondent attempts to lose weight slightly, WControl=3 if the respondent attempts to maintain the current weight, WControl=4 if the respondent is not engaging in any weight control activities, WControl=5 if the respondent attempts to gain a little weight, WControl=6 if the respondent attempts to gain a lot of weight.

Table 2: Descriptive Statistics

	Full Sample	Non-Smoker Sample	Smoker Sample		
			All Smokers	Quit=1	Quit=0
Quit	0.1116	0.0000	0.4790	1.0000	0.0000
	(0.3149)		(0.4999)		
CigTax	3.4289	3.7764	2.2844	2.5812	2.0115
	(1.3906)	(1.2138)	(1.3210)	(1.3782)	(1.2051)
BanPublic	4.3801	4.4941	4.0045	4.1625	3.8592
	(0.8497)	(0.7467)	(1.0397)	(0.9428)	(1.1029)
BanWork	4.1960	4.4159	3.4716	3.6938	3.2672
	(0.9963)	(0.7986)	(1.2161)	(1.1664)	(1.2267)
Education	0.9354	0.9186	0.9907	1.0616	0.9256
	(0.4629)	(0.4852)	(0.3753)	(0.3688)	(0.3699)
Age	0.4940	0.5009	0.4711	0.4591	0.4822
	(0.1169)	(0.1167)	(0.1144)	(0.1084)	(0.1188)
Sex	0.4878	0.3668	0.8862	0.8969	0.8764
	(0.4999)	(0.4820)	(0.3178)	(0.3046)	(0.3296)
Married	0.7936	0.7977	0.7799	0.7750	0.7845
	(0.4048)	(0.4018)	(0.4146)	(0.4182)	(0.4118)
Health	2.5321	2.5423	2.4985	2.5125	2.4856
	(0.9858)	(0.9966)	(0.9492)	(0.8992)	(0.9941)
Income	0.0042	0.0035	0.0064	0.0085	0.0044
	(0.0494)	(0.0427)	(0.0668)	(0.0788)	(0.0536)
Child	2.4630	2.5418	2.2036	2.0375	2.3563
	(1.4712)	(1.4523)	(1.5038)	(1.4292)	(1.5557)
SecondHand	1.9355	2.0223	1.6497	1.6625	1.6379
	(0.6711)	(0.6482)	(0.6662)	(0.6567)	(0.6756)
WControl	3.3298	3.2973	3.4371	3.2406	3.6178
	(1.9493)	(2.1749)	(0.8504)	(0.9208)	(0.7364)
HeardRisk	0.9135	0.9145	0.9102	0.9563	0.8678
	(0.2811)	(0.2796)	(0.2861)	(0.2049)	(0.3392)
Sample Size	2868	2200	668	320	348

Table 3: Attitude Toward Smoking-Related Public Policies

	Full Sample	Non-Smoker Sample	Smoker Sample		
			All Smokers	Quit=1	Quit=0
CigTax			Frequency		
(5) Strongly supportive	0.2936	0.3627	0.0659	0.1000	0.0345
(4) Somewhat supportive	0.2559	0.2786	0.1811	0.2375	0.1293
(3) Neither supportive nor against	0.1726	0.1900	0.1153	0.0938	0.1351
(2) Somewhat against	0.1416	0.1095	0.2470	0.2813	0.2155
(1) Strongly against	0.1363	0.0591	0.3907	0.2875	0.4856
BanPublic			Frequency		
(5) Strongly supportive	0.5485	0.6073	0.3548	0.4094	0.3046
(4) Somewhat supportive	0.3466	0.3141	0.4536	0.4531	0.4540
(3) Neither supportive nor against	0.0526	0.0500	0.0614	0.0469	0.0747
(2) Somewhat against	0.0411	0.0227	0.1018	0.0719	0.1293
(1) Strongly against	0.0112	0.0059	0.0284	0.0187	0.0374
BanWork			Frequency		
(5) Strongly supportive	0.4840	0.5649	0.2156	0.2719	0.1638
(4) Somewhat supportive	0.3407	0.3288	0.3817	0.4156	0.3506
(3) Neither supportive nor against	0.0795	0.0677	0.1183	0.0813	0.1523
(2) Somewhat against	0.0791	0.0341	0.2275	0.1969	0.2557
(1) Strongly against	0.0167	0.0045	0.0569	0.0344	0.0776
Sample Size	2868	2200	698	320	348

Table 4: Effects of Intention to Quit on Support for an Increase in Cigarette Tax[†]

	Endogenous Specification		**Exogenous Specification**	
	CigTax	Quit	CigTax	Quit
Quit	0.9464**	—	0.4707**	—
	(3.1015)	—	(5.3907)	—
Education	0.0225	0.0564**	0.0337**	0.0515**
	(1.2308)	(3.3233)	(2.2251)	(3.0129)
Age	0.0171**	-0.0002	0.0175**	-0.0017
	(3.2065)	(-0.0254)	(3.3141)	(-0.2658)
Sex	-0.1737	0.2081	-0.1292	0.2326
	(-1.3579)	(1.3160)	(-1.0193)	(1.4733)
Married	0.0813	0.0638	0.1105	0.0772
	(0.7082)	(0.4475)	(0.9378)	(0.5445)
Health	-0.0969**	0.0971*	-0.0840*	0.0938*
	(-2.1128)	(1.7190)	(-1.8046)	(1.6610)
Income	-0.0042	0.0065	-0.0039	0.0068
	(-0.2180)	(0.5536)	(-0.1938)	(0.5572)
Child	-0.0743*	-0.0053	-0.0850*	-0.0031
	(-1.7447)	(-0.1014)	(-1.9271)	(-0.0593)
SecondHand	0.1331**	0.0160	0.1349**	0.0309
	(2.0654)	(0.2111)	(2.0947)	(0.4070)
HeardRisk	—	-0.3034**	—	0.5794**
	—	(-4.9310)	—	(2.8441)
WControl	—	0.5585**	—	-0.3085**
	—	(2.7918)	—	(-5.0251)
α_1	2.7506**	—	2.7707**	—
	(7.0909)	—	(7.3449)	—
α_2	1.8977**	—	1.9023**	—
	(5.0449)	—	(5.1156)	—
α_3	1.5617**	—	1.5454**	—
	(4.2064)	—	(4.1946)	—
α_4	0.9204**	—	0.8878**	—
	(2.5052)	—	(2.4273)	—
Constant	—	-0.5754	—	-0.5106
	—	(-1.1510)	—	(-1.0196)
ρ_k	-0.3158		0.0000	
	(-1.5568)		—	
Log Like.	-1365.8779		-1367.0922	
Observations	668		668	
Hausman Test	2.6467 [0.1038]			
Overidentification Test[‡]	3.4428 [0.1788]			
Weak Instruments Test[†††]	39.1985 [3.0772e-009]			

[†]Asymptotic t-statistics are in parentheses and p-values are in square brackets.
[‡]Likelihood ratio test of the statistical significance of $\boldsymbol{Z}_{1i}$ in the CigTax equation.
[†††]Likelihood ratio test of the explanatory power of $\boldsymbol{Z}_{1i}$ in the Quit equation.
**Significant at 5% level.
*Significant at 10% level.

Table 5: Marginal Effects—CigTax

	CigTax=5	CigTax=4	CigTax=3	CigTax=2	CigTax=1
Quit	0.1220	0.1700	0.0502	0.0035	-0.3387
Education	0.0027	0.0043	0.0014	0.00020	-0.00821
Age	0.0020	0.0033	0.0010	0.0002	-0.0064
Sex	-0.0231	-0.0335	-0.0094	0.0012	0.0638
Married	0.0094	0.0154	0.0051	0.0012	-0.0302
Health	-0.0116	-0.0186	-0.0059	-0.0009	0.0364
Income	-0.0005	-0.0008	-0.0003	-0.0004×10^{-1}	0.0016
Child	-0.0089	-0.0142	-0.0045	-0.0007	0.0276
SecondHand	0.0124	0.0243	0.0095	0.0060	-0.0509
WControl	0.0001	0.0002	0.0000	0.0000	-0.0010
HeardRisk	-0.0002	-0.0004	-0.0001	-0.0003	0.0007

Table 6: Effects of Intention to Quit on Support for a Public Areas Smoking Ban†

	Endogenous Specification		**Exogenous Specification**	
	BanPublic	Quit	CigTax	Quit
Quit	0.9777**	—	0.3217**	—
	(3.3935)	—	(3.6162)	—
Education	-0.0001	0.0520**	0.0159	0.0486**
	(-0.0068)	(3.0309)	(1.0847)	(2.8212)
Age	0.0062	-0.0007	0.0042	-0.0014
	(1.2180)	(-0.1043)	(0.7905)	(-0.2284)
Sex	0.0077	0.2069	0.0366	0.1869
	(0.0590)	(1.2987)	(0.2711)	(1.1751)
Married	0.1228	0.0715	0.1375	0.0477
	(1.0447)	(0.5087)	(1.1738)	(0.3396)
Health	0.0063	0.0872	0.0332	0.0668
	(0.1381)	(1.5528)	(0.7207)	(1.1835)
Income	-0.0055	0.0060	-0.0053	0.0061
	(-0.8138)	(0.6894)	(-0.8713)	(0.7353)
Child	-0.0176	-0.0024	-0.0130	-0.0012
	(-0.4428)	(-0.0475)	(-0.3198)	(-0.0239)
SecondHand	0.0990	0.0037	0.1052	0.0040
	(1.4449)	(0.0485)	(1.5637)	(0.0515)
HeardRisk	—	-0.2963**	—	-0.2971**
	—	(-4.7807)	—	(-4.7733)
WControl	—	0.5889**	—	0.5903**
	—	(3.0869)	—	(2.9076)
α_1	1.3522**	—	1.2487**	—
	(3.7354)	—	(3.2525)	—
α_2	0.1682	—	-0.0220	—
	(0.4669)	—	(-0.0581)	—
α_3	-0.0998	—	-0.2933	—
	(-0.2753)	—	(-0.7786)	—
α_4	-0.8272**	—	-1.0760**	—
	(-2.1282)	—	(-2.7195)	—
Constant	—	-0.5235	—	-0.3594
	—	(-1.0250)	—	(-0.7031)
ρ_k	-0.4647**		0.0000	
	(-2.4296)		—	
Log Like.	-1237.181		-1240.3801	
Observations	668		668	
Hausman Test	5.7313 [0.0167]			
Overidentification Test‡	1.4412 [0.4864]			
Weak Instruments Test†††	39.1985 [3.0772e-009]			

†Asymptotic t-statistics are in parentheses and p-values are in square brackets.
‡Likelihood ratio test of the statistical significance of $\boldsymbol{Z}_{1i}$ in the BanPublic equation.
†††Likelihood ratio test of the explanatory power of $\boldsymbol{Z}_{1i}$ in the Quit equation.
**Significant at 5% level.
*Significant at 10% level.

Table 7: Marginal Effects—BanPublic

	BanPublic=5	BanPublic=4	BanPublic=3	BanPublic=2	BanPublic=1
Quit	0.3450	-0.0870	-0.0578	-0.1311	-0.0760
Education	-0.0003	$0.0006_{\times 10^{-1}}$	$0.0001_{\times 10^{-1}}$	$0.0005_{\times 10^{-1}}$	$0.0003_{\times 10^{-1}}$
Age	0.0023	-0.0006	-0.0004	-0.0009	-0.0005
Sex	0.0018	-0.0007	-0.0005	-0.0009	-0.0005
Married	0.0438	-0.0096	-0.0078	-0.0177	-0.0096
Health	0.0019	-0.0005	-0.0004	-0.0008	-0.0004
Income	-0.0020	0.0005	0.0004	0.0008	0.0004
Child	-0.0064	0.0016	0.0011	0.0025	0.0013
SecondHand	0.0344	-0.0049	-0.0062	-0.0150	-0.0089
WControl	0.0012	-0.0003	0.0000	-0.0002	-0.0001
HeardRisk	-0.0030	-0.0009	0.0000	0.0003	0.0003

Table 8: Effects of Intention to Quit on Support for a Workplace Smoking Ban†

	Endogenous Specification		Exogenous Specification	
	`BanWork`	`Quit`	`BanWork`	`Quit`
`Quit`	1.0391**		0.3901**	—
	(3.6414)		(4.4319)	—
`Education`	0.0100	0.0575**	0.0293**	0.0498**
	(0.5918)	(3.3902)	(2.0890)	(2.9105)
`Age`	2.0160**	-0.0468	2.0876**	-0.1823
	(3.9015)	(-0.0745)	(4.2856)	(-0.2891)
`Sex`	-0.1923	0.2260	-0.1481	0.2325
	(-1.3803)	(1.4339)	(-1.0713)	(1.4749)
`Married`	0.0232	0.1222	0.0548	0.0827
	(0.2026)	(0.8840)	(0.4864)	(0.5963)
`Health`	-0.0099	0.1007*	0.0144	0.0938*
	(-0.2153)	(1.7781)	(0.3286)	(1.6551)
`Income`	-0.0016	0.0059	-0.0015	0.0066
	(-0.2365)	(0.6648)	(-0.2447)	(0.7704)
`Child`	-0.0322	-0.0078	-0.0373	-0.0054
	(-0.7926)	(-0.1557)	(-0.9145)	(-0.1075)
`SecondHand`	0.2259**	0.0236	0.2439**	0.0261
	(3.2547)	(0.3098)	(3.6138)	(0.3430)
`WControl`	—	0.4856**	—-	0.5704**
	—	(2.5818)	—-	(2.7836)
`HeardRisk`	—	-0.3003**	—-	-0.2988**
	—	(-4.8961)	—-	(-4.7840)
α_1	2.4500**		2.5559**	—
	(6.4998)		(7.2380)	—
α_2	1.4249**		1.4641**	—
	(4.0038)		(4.2322)	—
α_3	1.1079**		1.1292**	—
	(3.1449)		(3.2746)	—
α_4	0.1044		0.0616	—
	(0.2985)		(0.1775)	—
Constant	—	-0.5884	—	-0.5025
	—	(-1.2095)	—	(-1.0007)
ρ_k	-0.4468**		0.000	
	(-2.3140)		—	
Log Like.	-1365.2054		-1367.4636	
Observations	668		668	
Hausman Test	5.7163 [0.0168]			
Overidentification Test‡	0.9456 [0.6233]			
Weak Instruments Test†††	39.1985 [3.0772e-009]			

†Asymptotic t-statistics are in parentheses and p-values are in square brackets.
‡Likelihood ratio test of the statistical significance of $\boldsymbol{Z}_{1i}$ in the `BanWork` equation.
†††Likelihood ratio test of the explanatory power of $\boldsymbol{Z}_{1i}$ in the `Quit` equation.
**Significant at 5% level.
*Significant at 10% level.

Table 9: Marginal Effects—BanWork

	BanWork=5	BanWork=4	BanWork=3	BanWork=2	BanWork=1
Quit	0.2980	0.0768	-0.0443	-0.2105	-0.1227
Education	0.00276	0.0009	-0.0005	-0.0021	-0.0011
Age	0.5810	0.1821	-0.0933	-0.4428	-0.2317
Sex	-0.0591	-0.0129	0.0102	0.0421	0.0198
Married	0.0064	0.0020	-0.0011	-0.0049	-0.0026
Health	-0.0031	-0.0010	0.0005	0.0023	0.0012
Income	-0.0005	-0.0002	0.0007×10^{-1}	0.0004	0.0002
Child	-0.0093	-0.0029	0.0015	0.0071	0.0037
SecondHand	0.0516	0.0365	-0.0040	-0.0466	-0.0376
WControl	0.0007	0.0003	0.0000	-0.0005	-0.0003
HeardRisk	-0.0012	-0.0010	0.0000	0.0005	0.0004

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