Drugs as a Rational Choice: Preliminary Explorations of Marijuana Consumption in Australia

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Abstract

Although an illegal commodity, Australian marijuana market is estimated to be in the size of as large as $5 billion annually. Understanding the consumer behaviour of illicit drug consumption is essential in drug policy debate. Using micro unit data from the most recent National Drug Strategy Household Surveys, ordered Probit model is estimated to study the effects of some social, economic and demographic factors on the frequency of an individual's marijuana consumption. A sequential model is also estimated that examines separately the decisions of whether to participate in regular consumption and how often to consume the drug. Results indicate that some factors may have opposite effects on the two decisions.

Key words: illicit drugs, marijuana demand, probit model.

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Drugs as a Rational Choice: Preliminary Explorations of Marijuana Consumption in Australia

Xueyan Zhao*

1. Introduction

In the most recent Australian drug survey conducted in 2001, 34% of the respondents aged 14 and over have reported use of marijuana, and 14% have reported regular use of at least once a year. While still an illicit drug in Australia, the consumption of marijuana among a significant proportion of Australians has persevered, and the price of marijuana has declined by almost 40% over the last decade (Clements, 2002). The trend towards hydroponic cultivation has prevailed in recent years which has significantly increased the productivity and product quality. During 2000/01, Australian law enforcement seized almost ten thousand kilograms of marijuana, almost twice of the seizure in the previous year (ABCI, 2001). According to an estimate by Clements and Daryal (1999), the expenditure on marijuana in Australia is almost twice of that on wine.

Commonly considered a ‘soft drug’, marijuana and its related drug policies have continued to be the center of debate in western societies. The issue is a complex one with health, social, political, as well as economic dimensions[1]. At the center of the discussion is whether legal sanction is the best approach to reduce the use of the drug, or whether marijuana market should be regulated just as the markets for alcohol and tobacco. Indeed, while the current marijuana market price is way below the production costs, the price premium has been taken by the underground dealers. Substantial tax revenue for the government would be generated if it were regulated.

No doubt, economic analysis will contribute to the discussion. There are many policy issues regarding the taxation of the drug and the potential economic implications to other related drug industries, if it were to be regulated. However, in the first instance, empirical study is

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crucial in understanding the consumer behavior of the current users for such an illegal commodity. For example, how many people are using it regularly? Who and where are the users? What are the impacts on consumption if it becomes decriminalized or regulated? How do the consumers respond to the changes of marijuana price? How is an individual's consumption of marijuana linked to his/her consumption of other legal (such as tobacco and alcohol) and illegal (such as heroin and cocaine) drugs? Unlike legal commodities, there are very limited data available for the marijuana market. Traditional demand analysis encounters difficulty due to absence of published quantity and price data.

This paper reports a preliminary investigation into the most recent data from the National Drug Strategy Household Surveys (NDSHS). Marijuana price data for individual states and territory are also obtained from the Australian Bureau of Criminal Intelligence, which are based on information from police undercover purchases. Clements and Daryal (1999) has used the consumption frequency data from NDSHS to estimate the sizes of the marijuana markets between 1988 and 1998. Cameron and Williams (2001) is the only economic study that has used the unit-record data from the Australian survey. While Cameron and William (2001) used the data from the four surveys between 1988 and 1995 to estimate a binary choice model explaining the decision of whether or not to use the drug, this paper will look at the three most recent NDSHS surveys of 1995, 1998 and 2001 to estimate a multiple discrete choice model. The focus here is on an individual's frequency of marijuana smoking and how that frequency responds to changes in marijuana price, drug policy in the state of residency, and other social, economic and demographic factors. A non-smoker may not choose to become a smoker because of a decrease in marijuana price while it is still illegal, but a monthly smoker maybe more likely to change to a weekly or daily smoker in response to a price change. Study of not only the participation but also the frequencies of consumption will enable a closer investigation of demand response given available data. A sequential model is also estimated in this paper that examines sequentially an individual's decisions of whether to smoke and how often/much to smoke. It is reasonable to speculate that the two decisions may be related to different explanatory factors.

Given the study is somewhat data driven, the paper will proceed with a description of the available data in Section 2. An ordered Probit model for all choices of frequencies of

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[1] See Clements and Daryal (1999) for a review of the debate.

marijuana consumption and a sequential model, consisting of a binary model and a multiple discrete choice model, are presented in Section 3. Results are analyzed in Section 4, and implications and further research are discussed in the final section.

2. The Data

There have been seven surveys since 1985 in the Australian National Drug Strategy Household Survey. The surveys collect information from individuals aged 14 and over on drug awareness, attitudes and behavior. The questions involve alcohol, tobacco, marijuana, heroin, cocaine, and other prescription or illegal drugs. The first survey in 1985 only has around 2,500 respondents, whereas in the 2001 survey over 26,000 individuals are involved. The questions are also becoming more comprehensive in later surveys. Various measures have been put in place in the surveys to reassure confidentiality to the respondents and to reduce under reporting. In this paper, data from the three most recent surveys of 1995, 1998 and 2001 are used which involve over 40,000 individuals.

The information about an individual’s consumption of marijuana is collected through questions such as “Have you ever used marijuana (or cannabis)” and “How often did you use marijuana (or cannabis) in the past 12 months”. Although questions are not designed exactly the same in the three surveys involved in this study, a variable Y is compiled from various questions in each survey that represents the frequency of an individual’s participation in marijuana consumption, with a value of zero for smoking less than once a year and an integer of l to 5 for smoking lower to higher frequencies. The proportions of individuals in each of the frequency categories for each of the three years and for the three years combined are given in Table 1.

As indicated in Table 1, the proportions of the population who smoke marijuana at least once a year are 13% for 1995, 19% for 1998, and 14% for 2001. While the proportions of regular smokers (and particularly the higher frequency bands of the regular smokers) are highest in 1998, overall there has been a relatively stable proportion of the population who participate in regular use of the drug since the late 1980’s.

The surveys also collect social, economic and demographic information for each respondent. In this paper, age, gender, marriage status, state of residence, work status, and income have been considered as explanatory factors from the surveys that may be related to the frequency of an individual's marijuana consumption.

The marijuana prices are obtained from information provided by ABCI. The data include detailed reports of prices by quarters from undercover buys in the forms of leaf, head, hydroponic, skunk, mature plant, hash/resin, or oil and purchased in various quantities. Clements (2002) has summarized the data into four annual price series from 1990 to 1999: prices for head or leaf, and purchased in grams or ounce. According to NDSHS (2001 and previous) these are the most popular form of purchases. In this paper, these four prices are weighted averaged into a single price for each year and each state, following Clements (2002).[2] Unfortunately, the 2001 price data has not been tidied up in the same way at the time of writing this paper, and the 1999 prices have been used as proxy for 2001.

3. The Models

3.1 An Ordered Probit Model for Marijuana Consumption

As we only observe the frequency of an individual's marijuana consumption rather than the actual quantity of the consumption, an ordered Probit model (Greene, 2000) is used to model a consumer's discrete choices. The choices are the frequencies of consumption and therefore have a natural ordering. Suppose the outcome of a consumer's choice from alternative frequencies is a reflection of an underlying latent regression

$$Y^* = \beta' X + \varepsilon \qquad (1)$$

where Y^* is an unobserved latent variable that represents the intensity of the consumer's demand for marijuana. Y^* is assumed to be related to a set of explanatory variables X. β is the parameter vector to be estimated, and $\varepsilon \sim N(0,1^2)$. Let Y represents the frequency of consumption, which is observable as

[2] The weights used are 70% for heads and 30% for leaves, and 80% in ounces and 20% in grams.

$$
(2) \qquad Y = \begin{cases} 0, & \text{never or less than once a year} \\ 1, & \text{once or twice a year} \\ 2, & \text{every few months} \\ 3, & \text{once a month} \\ 4, & \text{once a week or more} \\ 5, & \text{every day} \end{cases}
$$

Suppose the consumer will smoke more frequent as the value of Y^* becomes larger, and the relationship between Y and Y^* is given by

$$
(3) \qquad Y = \begin{cases} 0 & \text{if } Y^* \leq 0 \\ 1 & \text{if } 0 < Y^* \leq \mu_1 \\ 2 & \text{if } \mu_1 < Y^* \leq \mu_2 \\ 3 & \text{if } \mu_2 < Y^* \leq \mu_3 \\ 4 & \text{if } \mu_3 < Y^* \leq \mu_4 \\ 5 & \text{if } \mu_4 < Y^* \end{cases}
$$

where μ_i's are unknown threshold parameters that need to be estimated. When Normal distribution is assumed for the error term ε, the probabilities for $Y=j$ (j=0,…,5) can be expressed in Normal distribution function, and likelihood function obtained accordingly. Unknown parameters β and μ_i's can be estimated using maximum likelihood estimation. The marginal effect of each explanatory variable on the probability of demand falling in each frequency category can also be estimated accordingly. See Greene (2000) for details on ordered Probit model.

The explanatory variables in X considered in this preliminary study are age, gender, marriage status, work status, state of residency, personal income, and marijuana price at the place of residency. One of the aims in this study is to investigate the impacts of marijuana decriminalization. South Australia and ACT have both decriminalized small possession and cultivation of marijuana for personal use during the late 1980’s and early 1990’s, and Northern Territory also followed suit in 1996. Most of the sample observations in this paper are collected after the marijuana legislation change in these three states. While the consumers face different prices in different states which have been accounted for by the price variable, the legal status of marijuana in different states is also different. In this initial empirical exploration, state dummies are included to detect the effects of decriminalization and any other regional variations. Definition of all variables is given in Table 2.

3.2 A Sequential Model for Participation and Frequency of Consumption

It is not unreasonable to consider that an individual's decision on marijuana consumption has a sequential nature. The consumer is faced with two decisions: whether to participate in the consumption of an illicit drug which may involve criminal penalty, and then, given he/she has decided to participate, how frequent to smoke. The two decisions could well be related to different explanatory factors. For example, are the decriminalization status of marijuana and whether the person has family responsibilities more important in a person's decision for participation, while the level of price is more relevant to how often/much a person smokes once he/she is already a smoker?

Assume Y_0 is a binary variable representing whether a person frequently participate in marijuana consumption, with Y_0=1 for frequently smoking and Y_0=0 otherwise. Here, 'frequently smoking' is defined as smoking at least once or twice a year. A probit model is given by first defining a latent regression

(4) $$Y_0^* = \gamma_0' Z_0 + e_0$$

where Y_0^* is an unobserved latent variable that is related to a set of explanatory variables Z_0, γ_0 is the parameter vector to be estimated, and e_0 ~N(0,1^2) is the error term. The observability of Y_0^* via Y_0 is given by:

(5) $$Y_0 = \begin{cases} 1 & \text{if } Y_0^* > 0 \\ 0 & \text{if } Y_0^* \leq 0 \end{cases}$$

In other words, while the actual value of the demand is not observable, what is observable is whether the demand is bigger than zero. Similar to the ordered Probit model above, the binary Probit model can be estimated using maximum likelihood estimator (MLE), and the marginal effect of each explanatory variable Z_0 on the probability of marijuana participation can be estimated accordingly.

The second stage of the decision is conditional on Y_0=1 and only involves the smoker part of the sample. Once an individual has made the decision to participate, the second decision of how often to smoke is assumed to be related to a set of explanatory variables Z_1 through a latent regression:

(6) $$Y_1^* = \gamma_1' Z_1 + e_1$$

where e_1~N(0,1^2). Suppose the observable smoking frequency is represented by variable Y_1, with discrete values of 0 to 4 representing smoking 'once or twice a year' to 'every day'. Y_1 is related to the latent variable Y_1^* as

(7) $$Y_1 = \begin{cases} 0 & \text{if } Y_1^* \leq 0 \\ 1 & \text{if } 0 < Y_1^* \leq \delta_1 \\ 2 & \text{if } \delta_1 < Y_1^* \leq \delta_2 \\ 3 & \text{if } \delta_2 < Y_1^* \leq \delta_3 \\ 4 & \text{if } \delta_3 < Y_1^* \end{cases}$$

where δ_i's (i=1, 2, 3) are threshold parameters which can be estimated together with the coefficient vector γ_1 using MLE.

The joint probabilities for the second stage decision is given by

(8) $$P(Y_0 = 1,\ Y_1 = j \mid Z_0, Z_1) = P(Y_0 = 1 \mid Z_0) \times P(Y_1 = j \mid Y_0 = 1,\ Z_1),$$

where the two right hand side probabilities are given by the binary Probit model in Equations (4)-(5) and the ordered Probit model in Equations (6)-(7), respectively. In theory, the two sets of explanatory variables can be completely different, partly overlapping, or completely overlapping. In this paper, the same set of variables is used for all three models. The significance of individual explanatory variable will be compared.

4. Results

The models are estimated using LIMDEP computer program (Greene, 1995). Estimated coefficients for all models, together with *t*-statistics and *p*-values for significance tests, are given in Table 3. Marginal effects of individual explanatory variables on the probabilities of the three dependent variables are given in Table 4 and Table 5. As shown in Table 3, all the threshold parameters μ_i's and δ_i's are very significant with near zero *p*-values, indicating that the discrete choices in both Y and Y_1 are indeed ordered.

What do the results show about the effects of individual explanatory variables on a person's frequency of marijuana consumption? Look at the demographic variables first. Coefficients for AGE variable in Table 3 are very significant in all three equations. The positive signs of the coefficients show that, other factors equal, the intensity of demand decreases as a person gets older. The marginal effects of age on the value of frequency variable Y in Tables 4 indicate that, for an extra year older in age, the probability of a person being in the lower frequency categories are increased: 0.24% higher probability for Y=0 (non-smoker or smoking less than once a year) and 0.002% higher probability for Y=1 (once or twice a year). The probabilities for higher frequencies are decreased on the other hand when a person is one year older: by 0.01% for each of Y=2 and Y=3 group, 0.05% for Y=4, and 0.18% for the daily smoking group of Y=5. The marginal effects estimated in the sequential model show similar results on both the decisions of whether to smoke (Y_0) and how often to smoke (Y_1). Probability of marijuana participation (Y_0=1) is shown to decrease by 0.67% for each year older in age. Among regular smokers, the probabilities for smaller frequencies are higher when older (0.18% and 0.03% higher for Y_1=0 and Y_1=1 respectively for one extra year in age) and the probabilities for being heavier smokers are lower for older people (0.01%, 0.08% and 0.73% lower for Y_1=1, 2, and 3 respectively). Note that, with the ordered Probit setting, while the signs of marginal effects on the two end categories (P(Y=0) and P(Y=5)) can be determined unambiguously by the sign of the coefficient in the latent equation, the signs of the effects on the probabilities for the middle categories cannot be determined.

The gender effect is consistent across all three equations. Male is shown to be significantly more likely to smoke and to smoke heavily. The binary choice model shows in Table 5 that male on average has 4.35% higher probability to participate in regular marijuana consumption (Y_0=1), other factors being constant. Conditional on the person being a regular smoker, the probability of smoking only a couple of times a year (Y_1=0) is 12.41% lower for male than for female, for example, and the probability of smoking daily is 8.06% higher for male than female. In the combined single stage choice model among six frequencies of *Y*, the marginal probability changes exhibit the same direction but smaller magnitudes.

The effects of marriage status are interesting. Looking at the signs of the coefficients for dummy variable MARRIED for the three equations in Table 3, while being married has a significantly negative effect on the intensity of marijuana demand both when all choices are combined and when only binary choices are present, the effect on the intensity of demand among smokers is insignificant and positive at the 36% significance level (*p*-value=0.3526). The estimated marginal effects indicate that when faced with all choices (Table 4), the probabilities for lower smoking frequencies of *Y*=0 and *Y*=1 are marginally 4.05% and 0.04% higher respectively for a married person, but the probabilities for participating in higher frequency smoking are 0.09% (for Y=2), 0.18% (for Y=3), 0.83% (for Y=4) and 2.98% (for Y=5) higher. The assumed ordered nature across all six choices of Y values means that the effects have a uniform direction (one coefficient in the latent model for the variable MARRIED). However, once the decision is broken down to two stages, while being married is shown to decrease the probability of participation by 7.33% (Table 5, with a near zero *p*-value), whether the person is partnered may not be an important factor in the second decision of how often to smoke. In fact, being married may even have a positive effect on the intensity of demand. For example with a *p*-value of 35%, the results seem to suggest that within the regular smokers population, the probability of smoking daily is 0.73% higher for a married person.

Now look at the estimated coefficients for regional differences in comparison to the base state of Western Australia in Table 3. In the combined choice model for *Y*, all states are shown to have lower intensity of demand in comparison to WA, though only NSW and ATC coefficients are significant at the 5% significance level (all will be significant at 30% significance level). The marginal effects in Table 4 show, for example, a person from NSW has a 2.5% higher probability to be a non-regular smoker than a person from WA, but a 1.79% lower probability to be a daily smoker than a WA person. In the binary choice model, all states are shown to have significantly lower probabilities for participating in regular consumption than WA, with the lowest marginal decrease of 2.55% in probability for QLD and the highest marginal decrease of 4.73% in probability for NSW. Once only the regular smokers are considered in the ordered Probit model for Y_1, more state variables are shown to be significant again; all states except for SA and NT are shown to have significantly lower demand among smokers than WA.

As mentioned earlier, three states, i.e. SA, ACT and NT, have decriminalized small possession and cultivation of marijuana at the times when most of our sample observations were collected. While all states seem to have lower demand[3] than WA based on the estimated results, in terms of the probability for the binary choice of regular participation ($P(Y_0=1)$), there does not seem to be systematic difference between these three states and the others. However, when only the smokers are considered in the model for Y_1, it seems that, *ceteris paribus,* both SA and NT are closer in demand[4] to WA than other states, indicating higher probabilities of more frequent consumption than other states other than WA. Indeed, it is difficult to disentangle the decriminalization effect from other regional effects. Although different prices have been used for individual states which hopefully have accounted for some of the difference across states, there are other regional differences in addition to the difference in marijuana decriminalization policies. As argued by Clements (2002) based on the analysis of price information, there does seem to exist regional markets rather than a single national market for marijuana. Cameron and William (2001) pointed out that, based on the participation data across time, the proportion of a person in SA participating in marijuana consumption only increased temporarily during the few years straight after the policy change in 1987, and the proportion has dropped back to the same level as other states by 1995. The results from the binary part of the sequential model in this paper are consistent with this belief, indicating no significant difference in the first decision of participation between the three decriminalized states and the rest (except WA). However, more empirical evidence is needed to investigate any differences in the intensity of consumption among regular smokers. The results from the second part of the sequential model for smokers in this paper do show some differences for SA and NT from the rest of the states (except WA). Further investigation is also warranted as to why WA has consistent higher proportions of participation and more frequent smokers.

Turn now to the effects of social economic variables. The results for work status variables show that, in comparison to an employed person, being a student has a significant effect in reducing both the probabilities of participation (6% lower probability) and smoking heavily.

[3] as measured via the frequencies of smoking

On the other hand, at less than 1% significance level, an unemployed person has a higher probability of participating in regular smoking than an employed person (4% higher) and higher probability of smoking heavily among the smokers. Overall, at 8% significance level, being unemployed is also shown to have a positive effect on smoking when all choices are combined. For the last group of people who identify themselves as retired, undertaking home duty, or doing volunteer work without pay, at 5% significance level, their probability of regular participating is lower, but conditional on being smokers, their probability of heavily smoking is higher.

The results for personal income are rather interesting. The coefficient in the combined choice model for Y is not significant, while the coefficients in the two stages of the decision are significant with conflicting signs. The results seem to suggest that while a person with higher income has a higher probability of engaging in regular consumption (0.03% higher probability for every $1,000 of extra annual personal income), the income effect on the frequency of consumption is negative once the decision of participation is made. For example, the marginal effects indicate that, among regular smokers, every $1,000 more in annual income means a 0.28% higher probability of smoking only once or twice a year but a 0.18% lower probability of smoking daily. If we consider the frequency of consumption as an indicator of quantity of consumption, the income elasticity among regular smokers is of the sign that is opposite to that for a normal economic good. Further investigation is necessary to make sense of these results. While it makes sense that it would be difficult to maintain productivity and a high income if a person smokes heavily, it is hard to imagine a person without much income to be able to afford regular consumption[5]. These results also relate to the estimated impacts of work status variables, where a consistent positive effect is observed for being unemployed.

Lastly the results on the effects of price variations on the frequency of consumption are indeed puzzling. Neither of the coefficients in the first two equations (for Y and Y_0) for the price variable is significant, and the price effect in the third equation (Y_1) is significant and positive. It is almost certain that the results are related to the inaccuracy in the price data used. As pointed out in the data section, predicted price data for 2001 rather than the actual data are used in this preliminary study, while more than half of the observations in the sample

[4] as measured through smoking frequency

are from 2001. It will be interesting to see the results once the actual 2001 price data are included. As shown in Clements (2002), marijuana prices are the highest in NSW, and WA and SA have relatively low prices. The results in this study show that NSW have the lowest demand, WA and SA the highest. These indicate that the consumers maybe responding to the price differences.

5. Qualifications, Implications, and Further Research

Numerous qualifications should be pointed out in relation to this preliminary study. The price data need refining before a final conclusion can be drawn on the price responsiveness of the consumption. Some explanatory variables need closer investigation in order to best examine the impact of some explanatory factors. For example, while age is used as a continuous variable, some evidence shows the age effect may not be monotonous[6]. Interactive terms may also be added to the analysis to detect any interaction across different explanatory variables. Of course there are also the usual caveat for the ordered Probit model and the sequential model.

However, the preliminary investigation into the most recent surveys does provide some indication as to the factors contributing to the frequency of marijuana consumption. In addition, results from the sequential model used here suggest that there are maybe some fundamental differences in the behaviors of smokers and nonsmokers. There maybe very different factors that are important in the two decisions of whether to smoke and how often (and therefore how much) to smoke. Same factor can also have very different and even opposite effects in the two decisions, as indeed shown here.

This is a preliminary investigation into the Australian NDSHS data. A natural extension will be to look at the links of consumption of marijuana and the consumption of other legal and illegal drugs for the same consumer. These will be important in understanding the behavior of illicit drug consumers and in identifying any close substitute and complement commodities for marijuana in the usual economic sense.

[5] keeping in mind that a gram of marijuana may cost up to $20-$40.

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[6] Cameron and William (2001) show with age dummy variables that while all above 25 age groups have lower probabilities of participation than the <20 age group, the 20-24 age group has a higher probability of participation than the <20 group.

Table 1. Summary Frequencies of Marijuana Consumption

	1995		1998		2001		Combined	
	n_1	%	n_2	%	n_3	%	n	%
Y=0 Less often or never smoked	23,309	87.2	8,101	78.3	3,301	85.7	34,711	84.8
Y=1 Once or twice a year	980	3.7	605	5.9	183	4.8	1,768	4.3
Y=2 Every few months	634	2.4	302	2.9	83	2.2	1,019	2.5
Y=3 Once a month	430	1.6	267	2.6	87	2.3	784	1.9
Y=4 Once a week or more	794	3.0	452	4.4	125	3.2	1,371	3.3
Y=5 **Every day**	543	2.0	307	3.0	66	1.7	916	2.2
Missing	54	0.2	306	3.0	6	0.2	366	0.9
Total	**26,744**	**100**	**10,340**	**100**	**3,851**	**100**	**40,935**	**100**

Source: compiled from unit record data from NDSHS (1995, 1998 and 2001).

Table 2. Definition of Variables

Y	Frequency of marijuana consumption for all population: =0 if never smoked or smoking less than once a year; =1 if once or twice a year; =2 if every few months; =3 if once a month; =4 if once a week or more; and =5 if everyday.
$\mathbf{Y_0}$	Binary variable for regular marijuana participation for all population: =1 if smoking at least once a year, and =0 if less often or never smoked.
$\mathbf{Y_1}$	Frequency of marijuana consumption for regular smokers: =0 if smoking once or twice a year; =1 if every few months; =2 if once a month; =3 if once a week or more; and =4 if everyday.
AGE	Actual age as a continuous variable.
GENDER	=1 for male; and =0 for female.
MARRIED	=1 if married or de facto; and =0 otherwise.
NSW	=1 if resident of NSW; and =0 otherwise.
VIC	=1 if resident of VIC; and =0 otherwise.
QLD	=1 if resident of QLD; and =0 otherwise.
SA	=1 if resident of SA; and =0 otherwise.
TAS	=1 if resident of TAS; and =0 otherwise.
ATC	=1 if resident of ACT; and =0 otherwise.
NT	=1 if resident of NT; and =0 otherwise.
STUD	=1 if mainly study; and =0 otherwise.
UNEMP	=1 if unemployed; and =0 otherwise.
OTHER	=1 if retired, home duty, or volunteer work; and =0 otherwise.
INCOMEP	Personal annual income before tax ($'000).
LPRICE	Log of marijuana price.

Table 4. Marginal Effects for Ordered Probit Model of the Whole Sample (Y)*

Variable	Y=0	Y=1	Y=2	Y=3	Y=4	Y=5
AGE	.0024	$.2\times10^{-4}$	-.0001	-.0001	-.0005	-.0018
GENDER	-.0254	-.0002	.0006	.0011	.0053	.0186
MARRIED	.0405	.0004	-.0009	-.0018	-.0083	-.0298
NSW	.0250	.0001	-.0007	-.0012	-.0053	-.0179
VIC	.0140	.0001	-.0004	-.0007	-.0029	-.0101
QLD	.0124	.0001	-.0003	-.0006	-.0026	-.0090
SA	.0197	.0001	-.0005	-.0009	-.0042	-.0142
TAS	.0213	.0001	-.0006	-.0010	-.0045	-.0152
ACT	.0237	.0001	-.0006	-.0011	-.0050	-.0170
NT	.0164	.0001	-.0004	-.0008	-.0034	-.0119
STUD	.0318	.0001	-.0009	-.0016	-.0068	-.0226
UNEMP	-.0244	-.0004	.0005	.0010	.0049	.0183
OTH	-.0029	.0000	.0001	.0001	.0006	.0021
INCOMEP	$.6\times10^{-4}$	$.5\times10^{-6}$	$.1\times10^{-5}$	$-.3\times10^{-5}$	$-.1\times10^{-4}$	$-.4\times10^{-4}$
LPM	.0003	$.2\times10^{-5}$	$-.6\times10^{-5}$	$-.1\times10^{-4}$	-.0001	-.0002

* Figures in are marginal changes of respective probabilities. Marginal effects for dummy variables are measured as $P(Y=j|X_k=1)-P(Y=j|X_k=0)$.

Table 5. Marginal Effects for the Sequential Model*

	Binary Model (Y_0)	Ordered Probit for Regular Smokers (Y_1)				
Variable	$Y_0=1$	$Y_1=0$	$Y_1=1$	$Y_1=2$	$Y_1=3$	$Y_1=4$
AGE	-0.0067	.0018	.0003	-.0001	-.0008	-.0012
GENDER	0.0435	-.1241	-.0176	.0064	.0546	.0806
MARRIED	-0.0733	-.0109	-.0017	.0005	.0048	.0073
NSW	-0.0473	.0787	.0084	-.0059	-.0354	-.0458
VIC	-0.0271	.0844	.0086	-.0066	-.0380	-.0485
QLD	-0.0255	.0817	.0092	-.0059	-.0366	-.0483
SA	-0.0344	.0277	.0037	-.0016	-.0124	-.0174
TAS	-0.0397	.0507	.0060	-.0035	-.0228	-.0305
ACT	-0.0459	.0961	.0097	-.0075	-.0432	-.0550
NT	-0.0324	.0215	.0030	-.0012	-.0096	-.0138
STUD	-0.0606	.1543	.0122	-.0140	-.0692	-.0833
UNEMP	0.0421	-.0737	-.0151	.0007	.0312	.0569
OTH	-0.0107	-.0468	-.0084	.0013	.0203	.0337
INCOMEP	0.0003	.0028	.0004	-.0001	-.0012	-.0018
LPM		-.0051	-.0008	.0002	.0023	.0034

* Figures in are marginal changes of respective probabilities. Marginal effects for dummy variables are measured as $P(Y_0=1|Z_{0,k}=1)-P(Y_0=1|Z_{0,k}=0)$ or $P(Y_1=j|Z_{1,k}=1)-P(Y_1=j|Z_{1,k}=0)$.

Table 3. Estimated Coefficients for Latent Equations*

	Ordered Probit (Y)			Sequential Model					
				Binary Probit (Y_0)			Ordered Probit for Smokers (Y_1)		
	Coefficient	**t**	**p-value**	**Coefficient**	**t**	**p-value**	**Coefficient**	**t**	**p-value**
CONSTANT	0.4893	15.18	0.000	0.6334	14.15	0.000	0.0843	11.32	0.000
AGE	-0.0061	-12.49	0.000	-0.0375	-43.15	0.000	-0.0051	-2.84	0.005
GENDER	0.0643	4.74	0.000	0.2389	12.52	0.000	0.3573	11.47	0.000
MARRIED	-0.1028	-7.39	0.000	-0.3942	-19.72	0.000	0.0316	0.93	0.353
NSW	-0.0631	-2.13	0.033	-0.3020	-7.55	0.000	-0.2187	-3.40	0.001
VIC	-0.0355	-1.14	0.256	-0.1641	-3.94	0.001	-0.2339	-3.57	0.000
QLD	-0.0315	-1.08	0.280	-0.1518	-3.97	0.001	-0.2282	-3.82	0.000
SA	-0.0499	-1.45	0.148	-0.2166	-4.62	0.000	-0.0788	-1.05	0.294
TAS	-0.0537	-1.59	0.112	-0.2551	-5.57	0.000	-0.1423	-1.93	0.054
ATC	-0.0599	-2.06	0.039	-0.2887	-7.41	0.000	-0.2660	-4.27	0.000
NT	-0.0415	-1.45	0.149	-0.1946	-5.08	0.000	-0.0614	-1.02	0.308
STUD	-0.0804	-3.28	0.001	-0.4173	-13.51	0.000	-0.4217	-8.99	0.000
UNEMP	0.0621	1.75	0.081	0.2087	4.73	0.000	0.2258	3.58	0.000
OTHER	0.0074	0.38	0.705	-0.0606	-2.05	0.04	0.1393	2.64	0.008
INCOMEP	-0.0002	0.66	0.659	0.0015	3.12	0.002	-0.0080	-9.02	0.000
LPRICE	-0.0007	-0.44	0.785	0.0022	-0.67	0.501	0.0148	2.87	0.004
μ_1	0.222	42.11	0.000						
μ_2	0.383	53.99	0.000				δ_1: 0.476	36.71	0.000
μ_3	0.536	61.62	0.000				δ_2: 0.828	54.05	0.000
μ_4	0.957	70.57	0.000				δ_3: 1.588	73.47	0.000
Sample Size	34,621			34,621			5,262		

* WA is the base of comparison for state dummies, and ‘employed’ is the base of comparison for work status dummy variables.