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Cannabis and cocaine, jobs and wages

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Abstract

This paper uses a dataset collected among inhabitants of Amsterdam, to study the employment and wage effects of the use of cannabis and cocaine. From the analysis it appears that conditional on having a job the use of these drugs does not affect wages. The use of cannabis and cocaine is negatively correlated with employment rates. However, the fact that drug users are less likely to be employed has to do mostly with (unobserved) personal characteristics and not with causality.

Keywords: drugs, employment, wages, cannabis, cocaine
JEL codes: C41, D12, I19

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1 Introduction

Soft and hard drugs are often related to detrimental effects on its users concerning health and labor market position. Although the negative relationship between illicit drug use and productivity seems plausible, it is not often found in empirical research.[2] Kaestner (1991) for example finds that increased frequency of use of cocaine or marijuana is associated with higher wages. Gill and Michaels (1992) and Register and Williams (1992) find very similar results. The results suggest that adolescent alcohol and soft drug use have little or no effect on the earnings of men in their late twenties or thirties, although they do find that early hard drug use has a significant negative impact. Kaestner (1994) finds a negative association between marijuana (cannabis) or cocaine use and the hours of labor supplied by young males. Zarkin et al. (1998) find no significant relationship between past month labor supply and the use of cigarettes, alcohol or cocaine in the past month. They do find a significant positive association with past month cannabis use. MacDonald and Pudney (2000a and 2000b) use British data to estimate a joint model covering past and current drug use together with unemployment and occupational attainment. They conclude that there is an effect of past hard drug use on current drug use. Past use of soft drugs tends not to be significantly associated with current unemployment, the past use of hard drugs does. Overall, there is strong evidence of long-term damage to employment prospects from the use of hard or dependency drugs. There is very little evidence of any relationship between the impact of drug use on occupational attainment for those in work. So, there is a growing body of empirical evidence that suggests that once endogeneity is accounted for, one rarely finds a significant negative relationship between substance abuse and wages.

[2] There are also studies on the relationship between wages and the use of alcohol and tobacco. The use of alcohol is often found to have a positive effect on wages, while the use of tobacco has a negative effect on wages. See Van Ours (2002) for an overview of this literature.

The current paper is on the labor supply effects of the consumption of cannabis and cocaine. In the analysis data are used that were collected in Amsterdam (the capital of the Netherlands) during surveys in 1990 and 1994. The situation in Amsterdam is interesting from a research point of view since the Netherlands is one of the few countries with a liberal attitude towards the use of soft drugs like cannabis.

The paper is set up as follows. Section 2 gives stylized facts about the use of drug use, employment and wages in Amsterdam. Section 3 analyzes the dynamics in the consumption of cannabis and cocaine. Section 4 presents a preliminary analysis of relationships between drug use and employment. Section 5 analyzes the relationship between the use of cannabis and cocaine and labor supply variables in more detail. It appears that wages are not much affected by the use of cannabis and cocaine but there is a negative effect of cocaine use on the probability of having a job. Section 6 addresses the issue of whether there is a causal relationship between drug use and labor supply variables or merely correlation caused by unobserved characteristics. Section 7 concludes.

2 Drugs and labor supply in Amsterdam

2.1 Amsterdam

The Netherlands has a special type of drug policy. The main aim is to protect the health of individual users, the people around them and society as a whole.[3] There are clinics for the treatment of addicts and care services, which aim to reach as many addicts as possible to assist them in efforts to rehabilitate, or to limit the risks caused by their drug habit. Methadone

[3] See Ministry of Health, Welfare and Sport (1997) from which I derived most of the information in this section. An international perspective on Dutch drug policy is given in Boekhout van Solinge (1999).

programs enable addicts to lead reasonably normal lives without causing nuisance to their immediate environment, while needle exchange programs prevent the transmission of diseases such as AIDS and hepatitis B through infected needles. The services also provide counseling.

Regulations on drugs are laid down in the Opium Act, which draws a distinction between hard drugs and soft drugs. The distinction that is drawn relates to the health risks involved in drug use. Hard drugs are those substances which can seriously harm the health of the user and include heroin, cocaine an synthetic drugs such as ecstasy. Soft drugs, i.e. cannabis derivatives marijuana and hashish cause far fewer health problems. The possession of hard drugs is a crime. However, since 1976 the possession of a small quantity of soft drugs for personal use is a minor offence.

The data used in the analysis are collected in Amsterdam. Out of the population of 700.000, Amsterdam has around 5000 hard-drug users. Around 2000 are of Dutch origin, 1350 have roots in former colony of Surinam, the Netherlands Antilles and Morocco. Around 1750 users come from other European countries, mainly Germany and Italy. Amsterdam has around 300 recognized, so-called "coffee-shops" were soft drugs can be purchased.

2.2 Data

The data are from two subsequent but separate surveys by CEDRO, the Center for Drug Research of the University of Amsterdam (see Abraham et al. (1998) for a more detailed description). The surveys were carried out in 1990 and 1994. There are some differences between the surveys, but the information used in this paper is collected consistent through time. The data on drug use are based on self-reported information, which is the norm for analyses of drug consumption. The survey population is defined as all persons in the Municipal Population Registry of Amsterdam. The 1990 survey was paper-written. In 1994 two interview methods were applied, a written and a computer assisted version. The sample was randomly subdivided into two equal sized samples. It turned out that the interview method did not affect the answers to the questions.

Figure 1 shows the relationship between employment rates and age of the individuals in our sample. Until age 25 there is only a slight difference between males and females. After that there is an obvious difference between males and females. Between age 26 and 45 employment rates of males are about 80%, while it is about 50% to 60% for females. Beyond age 45 the employment rates go down. In the quantitative analysis I restrict myself to prime age individuals, that is individuals between age 25 and 50. Figure 2 shows the relationship between wages and age. As described in more detail in the appendix the wage information is given in classes ranging from 1 to 9. The figure shows the arithmetic averages of the scale from 1 to 9. Again, there is not much difference between males and females until age 25. At higher age the differences are becoming larger. One of the reasons of the increasing difference may be that the percentage of part-time workers among females is increasing while this percentage among males is declining over the age.

2.3 Labor supply and drug use

Table 1 shows lifetime and last year prevalence for cannabis and cocaine distinguished between non-participating, unemployed and employed males and females. The average lifetime cannabis prevalence is 50% for males and 40% for females, where it should be noted that this concerns the age group 26-50 years. For both males and females lifetime cannabis use is highest among currently unemployed workers although for females the difference between employed and unemployed workers is small. Last year cannabis prevalence is 9% for females and 19% for males. Again, unemployed workers have the highest prevalence, although for males it is not that much different from the prevalence of non-participating males. The lifetime and last year prevalence for cocaine are at a substantially lower level, but the overall pattern is the same: higher for males than for females, highest among unemployed workers.

Table 2 shows average participation rates, unemployment rates and wages distinguished for different groups of users and non-users of cannabis and cocaine. For males participation rates and unemployment rates are always higher for users than they are for non-users while there are hardly any differences concerning the wage. For females the same pattern holds for wages and unemployment rates. However, participation rates are usually higher for females that have used cannabis or cocaine. Only when it come to last year prevalence of cocaine the participation rate is lower for users than it is for non-users.

3 Dynamics of drug use

Figure 3 shows the cumulative starting probabilities of cannabis and cocaine.[4] As shown the cumulative starting probability of cannabis increases from about 5% at age 15 up to 35% at age 25. After that the cumulative starting probability hardly increases. The pattern for cocaine is about the same although here the increase is only small after age 30 at a level of about 8%.

To investigate the determinants of the starting rates of cannabis and cocaine I use a bivariate mixed proportional hazard model with a flexible baseline hazard. Differences between individuals in the rate by which they start using a particular drug are characterized by the observed characteristics x, the elapsed duration of time they are exposed to potential use and unobserved characteristics v. I take age 12 to be the time at which this potential

[4] Note that these starting probabilities are calculated on the basis of the complete sample whereas the numbers in Figure 1 are calculated on the basis of the specific age categories.

exposure to drugs starts.

The starting rate for cannabis and cocaine, at time t conditional on observed characteristics x and unobserved characteristics v is specified as:[5]

$$\theta_j(t \mid x, v) = \lambda_j(t)\exp(x'\beta_j + v_j) \text{ for } j = a, b \tag{1}$$

where $\lambda(t)$ represents individual duration dependence, v represents individual specific unobserved heterogeneity, the subscript a represents cannabis and the subscript b represents cocaine. I model flexible duration dependence by using a step function:

$$\lambda_j(t) = \exp(\Sigma_k \lambda_{jk} I_k(t)) \text{ for } j = a, b \tag{2}$$

where k (= 1,..,20) is a subscript for age-intervals and $I_{jk}(t)$ are time-varying dummy variables that are one in subsequent age-intervals. I distinguish 20 age intervals of which 19 are of 1 year (age 12, 13, 14, .., 30) and the last interval is open: 30+ years. Because I also estimate a constant term, I normalize $\lambda_{j1} = 0$.

The conditional density functions of the completed durations of non-use can be written as

$$f_j(t \mid x, v_j) = \theta_j(t \mid x, v_j)\exp(-\int_0^t \theta_j(s \mid x, v_j)ds) \text{ for } j = a, b \tag{3}$$

I take the possible correlation between the unobserved components into account by specifying the joint density function of the two durations of non use t_a and t_b conditional on x as

$$f(t_a, t_b \mid x) = \int_{v_b}\int_{v_a} f_a(t_a \mid x, v_a) f_b(t_b \mid x, v_b) dG(v_a, v_b) \tag{4}$$

$G(v_a, v_b)$ is assumed to be a discrete distribution 4 points of support (v_a^a, v_b^a), (v_a^a, v_b^b), (v_a^b, v_b^a), (v_a^b, v_b^b). The associated probabilities are denoted as follows:

$$\Pr(v_a = v_a^a, v_b = v_b^a) = p_1 \qquad \Pr(v_a = v_a^a, v_b = v_b^b) = p_2$$

[5] I assume that there is no causal relationship from cannabis to cocaine. See Van Ours (2001) for a discussion of this relationship.

$$\Pr(v_a = v_a^b, v_b = v_b^a) = p_3 \qquad \Pr(v_a = v_a^b, v_b = v_b^b) = p_4 \tag{5}$$

where p_n $(n = 1, .., 4)$ is assumed to have a multinomial logit specification:

$$p_n = \frac{\exp(\alpha_n)}{\Sigma_n \exp(\alpha_n)} \tag{6}$$

and I normalize $a_4 = 0$.

The parameters are estimated using maximum likelihood. In the estimates observations of individuals that did not start to consume cannabis or cocaine are considered to be right censored durations. The parameter estimates are presented in Table 3. The variable "birth year" has a positive effect on each of the starting rates for both males and females. This is a cohort effect. Later generations are more likely to start using cannabis and cocaine. Education has a negative effect on the starting rate for cocaine but only for females. The parameter estimates also indicate clear evidence of unobserved heterogeneity. For both females and males I could only identify three groups, which for unknown reasons behave differently. For females there is conditional on age and observed characteristics a group of 8.7% that has both a high starting rate for cannabis and a high starting rate for cocaine. There is also a group of 65.3% that has very small starting rates for both cannabis and cocaine. The remaining group has a high starting rate for cannabis and a low starting rate for cocaine (26.0%). For males there is conditional on age and observed characteristics a group of 13.7% that has both a high starting rate for cannabis and a high starting rate for cocaine. There is also a group of 61.2% that has very small starting rates for both cannabis and cocaine. The remaining group has a high starting rate for cannabis and a low starting rate for cocaine (25.1%).

4 Preliminary analysis

Figures 4 and 5 show the relationship between age and lifetime prevalence of cannabis and cocaine by age group. Figure 4 shows that for every age group lifetime prevalence of cannabis is higher for males than it is for females. Lifetime prevalence goes up with age initially and then declines. The upward effect is an age effect, the decline is related to a cohort effect: younger cohorts are more likely to use cannabis than older cohorts are. Figure 5 shows by and large the same pattern for cocaine. Before age 20 not many individuals use cocaine. The peak in the lifetime prevalence for cocaine is in the age category 31-35 for females and 36-40 for males. A large part of the individuals older than 45 have not used cocaine very frequently.

4.1 Drug use and employment

To investigate the information contained in the data about drug use and employment I did a preliminary analysis in which two time periods are distinguished. The first period is the past up to 1 year before the survey. The second period is the last year before the survey, which I define as the current period. The analysis is similar to the one presented in MacDonald and Pudney (2000a) and is done separately for females and males and for cannabis and cocaine.[6]

The variable $y^*_{j,1}$ represents the propensity to use drug j ($j = a, b$) in period 1 and drives the observed indicator of actual drug use $y_{j,1}$ through the probit mechanism:

$$y^*_{j,1} = x'\beta_{j,1} + \varepsilon_{j,1} \tag{7}$$

$$y_{j,1} = \psi(y^*_{j,1} > 0) \tag{8}$$

[6] MacDonald and Pudney (2000b) distinguishes three periods, up to one year before the survey, from one year up to a month before the survey, a month before the survey. In both papers by MacDonald and Pudney a trichotomous indicator is used: no use, soft drugs only, hard drugs (with or without) soft drugs. Table A2 in the appendix gives numbers of observations present in the current dataset according to this set-up.

where $\psi(.)$ is an indicator function, with a value 1 if the argument is true and a value 0 otherwise.

In the second period drug use is determined jointly with employment at the time of the survey, which involves a bivariate probit model that is based on a system of two latent variables:

$$y_{j,2}^* = x'\beta_{j,2} + \delta_c y_{j,1} + \varepsilon_{j,2} \tag{9}$$

$$e^* = x'\gamma_e + \delta_e y_{j,1} + \nu_e \tag{10}$$

where e^* represents the latent employment variable and $\varepsilon_{j,2}$ and ν_e are errors with bivariate normal distributions (for $j = a, b$) with zero means, unit variances and correlation ρ, conditional on $\{x, y_{j,1}\}$. The coefficients δ_c and δ_e capture the effect of drug use in the previous period. So, in this set-up I investigate the effect of past cannabis use on current cannabis use and employment separately from the effect of past cocaine use on current cocaine use and employment.

Table 4 shows the parameter estimates, which I discuss column-wise. Past use of cannabis for females declines with age, which is a cohort effect (see also Figure 4). Higher educated females are more likely to have used cannabis in the past. Current use of cannabis by females is only affected by age, which is now a true age effect and by past cannabis use. Past users of cannabis are more likely to be current users. Although this might indicate persistence in use (addiction) one has to keep in mind that the past period is very long compared to the current period of one year. Because of the time pattern in the starting rates for cocaine the transition from non-use to use is far less likely than the transition from use to non-use. The current employment position of females is affected only by their education. Higher educated females are much more likely to have a job than low educated females. Past use of cannabis has no effect on current employment. The coefficient of correlation between current use of cannabis and employment is significantly negative. Whether this indicates that female cannabis users are less likely to have a job or jobless females are more likely to use cannabis is not clear.

Past use and current use of cocaine by females are not influenced by personal characteristics. It's only past use of cocaine that has an effect on current use. Past use of cocaine also has a negative influence on the employment position of females but the relevant coefficient does not differ significantly from zero. Also, the coefficient of correlation between current use of cocaine and current employment is insignificant. So, female cocaine users are as likely to have a job as non-users are.

By and large the parameter estimates for males are similar to those for females. Past cannabis use drops with age and is higher for higher educated males. Current cannabis use also falls with age, and is lower for higher educated males. Also for males past cannabis use has a large effect on current cannabis use. The probability of having a job increases with age and is higher for higher educated males. Different from females for males there is a negative effect of past cannabis use on the probability of having a job. Also for males the coefficient of correlation between current use of cannabis and employment is significantly negative. Past cocaine use and current cocaine use is not influenced by personal characteristics of males. Also for males past cocaine use has a negative effect on the probability of having a job.

4.2 Drugs, employment and wages

To investigate the effect of cannabis and cocaine use I continue bringing in wages into the analysis. For this I specify an employment equation

$$e^* = x'\gamma_e + \delta_{a,e} y_{a,1} + \delta_{b,e} y_{b,1} + \nu_e \tag{11}$$

where now both the effect of past cannabis use and the effect of past cocaine use are in the employment equation and a wage equation

$$\ln w = z'\gamma_w + \delta_{a,w} y_{a,1} + \delta_{b,w} y_{b,1} + \nu_w \tag{12}$$

where w refers to the wage, again with both past cannabis use and past cocaine use in the wage equation. The correlation between the errors ν_e and ν_w takes into account that w is observed only if $e = 1$. As additional variables in the employment equation I introduce whether or not an individual is single and whether or not he or she has children. In the wage equation I have a dummy variable for a parttime job. Table 5 shows the parameter estimates.

Single females and males and females with children are less likely to have a job while males with children are more likely to have a job. Past cocaine use has a negative effect on the probability of having a job. Past cannabis use for males has a negative effect on the probability of having a job, but for females past cannabis use has a positive effect. The other parameters of the employment equation are very similar to the ones presented in Table 4.

Table 5 also shows that wages increase with age and are higher for higher educated workers. As expected parttime jobs earn less. Neither past cannabis use nor past cocaine use has an effect on the wages.

5 Drugs, employment and wages reconsidered

The most important conclusion from Table 5 is that past drug use - except cannabis in the case of females - seems to have a negative effect on the probability to have a job. However, even although because of the timing of events there is no simultaneous relationship between current employment status and past drug use we cannot conclude from Table 5 that there is a causal relation from past drug use to current employment status. It could be that the negative effect is driven by unobserved characteristics of individuals that make them more likely to use drugs and less likely to have a job. To investigate this possibility I combined the bivariate starting rate model for cannabis and cocaine of Section 3, from which it was clear that there is unobserved heterogeneity with the model of Section 4.2 where I introduce two mass points ($\gamma^*_{0,e}$ and $\gamma^*_{0,w}$) in both equations:

$$e^* = \gamma^*_{0,e} + x'\gamma_e + \delta_{a,e}y_{a,1} + \delta_{b,e}y_{b,1} + \nu_e \tag{13}$$

$$\ln w = \gamma^*_{0,w} + z'\gamma_w + \delta_{a,w}y_{a,1} + \delta_{b,w}y_{b,1} + \nu_w \tag{14}$$

The estimation results are shown in Table 6. It appears that most of the coefficients are hardly affected by combining the two models. From a Likelihood Ratio (LR) test for females it appears the introduction of additional mass points in the employment and wage equations does not improve the estimation results.[7] Again for females there does not seem to be a negative effect of past cannabis use or past cocaine use on employment or wages. On the contrary, past cannabis use has a positive effect on the probability of having a job. Nevertheless from a LR-test it appears that it is not possible reject that the parameters of past cannabis use and past cocaine use are jointly insignificant.

For males the introduction of additional mass points in the employment and wage equations improves the overall estimation results. Now, neither past cannabis use nor past cocaine use has an effect on employment or wages. The effects are neither individually nor jointly significant. Therefore, the observed negative effect of cocaine use on employment status in earlier estimates seems to be related to unobserved heterogeneity rather than to a causal relationship. So, the introduction of unobserved heterogeneity does not affect the parameter estimates for females very much but has a significant effect on the parameter estimates for males. If unobserved heterogeneity is accounted for, the negative effect of past cocaine use on the probability of having a job diminishes and is no longer significantly different from zero.

[7] As shown the LR-test statistic has a value of 2.4, whereas the critical value for two degrees of freedom is 6.0.

6 Conclusions

This paper deals with the possible detrimental effects of the use of cannabis and cocaine on employment and wages. The analysis shows that conditional on having a job the use of neither cannabis nor cocaine affects wages. The use of these drugs is correlated with lower employment rates. However, the fact that individuals that use these drugs are less likely to be employed has to do mostly with (unobserved) personal characteristics and not with a causal relationship. After correcting for unobserved personal characteristics there does not seem to be an effect of drug use on labor market position.

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7 Appendix: Information about the dataset

The gross sample consists of 6171 observations. I reduced this sample by using a number of criteria. Because the focus of the current paper is on employment and wages I only consider individuals who were between age 25 and age 50 at the time of the survey. The individuals in this age category have finished their education and have made the choice about whether or not to participate in the labor market. Because some studies find individuals from ethnic minority groups to underreport drug consumption I focus on individuals born in the Netherlands with a Dutch nationality. I did the analyses separately for males and females. After removing observations with incomplete information the net samples contain 1465 females and 1467 males. In the analysis the following explanatory variables are used:

- Age: Age of individuals at the time of the survey.
- Primary education: Dummy variable with a value of 1 if the individual attended extended primary education after having attended basic education, and a value of 0 otherwise.
- Secondary education: Dummy variable with a value of 1 if the individual attended secondary general or vocational education, and a value of 0 otherwise. Secondary education refers to intermediate vocational or secondary general education.
- Higher education: Dummy variable with a value of 1 if the individual attended higher vocational or academic education, and a value of 0 otherwise. Since there are three dummy variables for education the overall reference group consists of individuals with only basic education.
- Single: Dummy variable with a value of 1 if the individual is living alone and a value of 0 if the individual is part of a multi-person household.

- Children: Dummy variable with a value of 1 if the individual has children and a value of 0 otherwise.
- Employed: Dummy variable with a value of 1 if the individual is employed and a value of 0 otherwise.
- Wage: Variable with values 1-9 representing income classes, defined as own income in guilders per month. 1 = $<$ 500, 2 = 500-999, 3 = 1000-1499, 4 = 1500-1999, 5 = 2000-2499, 6 = 2500-2999, 7 = 3000-3999, 8 = 4000-4999, 9 = $\geq$ 5000.
- Part-time: Dummy variable with a value of 1 if the individual has a part-time job and a value of 0 otherwise.
- Year 1994: dummy variable with a value of 1 if the individual was questioned in 1994 and a value of 0 otherwise.
- Birth year: year of birth.
- Life time prevalence cannabis
- Life time prevalence cocaine

Table A1 presents some characteristics of the dataset used in the analysis.

Table A1 General characteristics of the dataset

	Mean		Minimum	Maximum
	Females	Males		
Age	36.5	35.9	26	50
Primary education	0.28	0.23	0	1
Secondary education	0.22	0.26	0	1
Higher education	0.44	0.46	0	1
Single	0.44	0.38	0	1
Children	0.41	0.30	0	1
Participation	0.69	0.88	0	1
Employed	0.62	0.81	0	1
Wage	4.10	5.30	1	9
Part-time	0.28	0.10	0	1
Cannabis lifetime prev	0.42	0.51	0	1
Cannabis last year prev	0.09	0.20	0	1
Cocaine lifetime prev	0.10	0.15	0	1
Cannabis last year prev	0.02	0.03	0	1
Survey 1994	0.52	0.52	0	1
N	1465	1467	-	-

Table A2 Cannabis, cocaine and employment; number of observations

a. employed and non-employed by use of cannabis and cocaine

Employed	Drug use in[a]		Males		Females	
	Period 1	Period 2	Cannabis	Cocaine	Cannabis	Cocaine
no	no	no	109	207	397	542
no	no	yes	1	0	1	0
no	yes	no	76	58	143	44
no	yes	yes	95	16	61	16
yes	no	no	659	1094	517	858
yes	no	yes	6	1	2	3
yes	yes	no	386	126	351	75
yes	yes	yes	195	25	77	11
			1527		1549	

b. Combinations of use of cannabis and cocaine[b]

Drug use in[a]		Males	Females
Period 1	Period 2		
none	none	760	908
none	cannabis	7	3
none	cocaine	0	0
cannabis	none	381	414
cannabis	cannabis	153	75
cannabis	cocaine	1	3
cocaine	none	80	77
cocaine	cannabis	104	42
cocaine	cocaine	41	27
		1527	1549

[a] Period 1 = up to 1 year, period 2 = 1 year before the survey date

[b] When cocaine is indicated this may or may not be joint with cannabis

Table 1 Lifetime and last year prevalence of cannabis and cocaine for different groups in the labor market[a)]

	Females				Males			
	NP	U	E	Total	NP	U	E	Total
Cannabis prevalence								
Lifetime	0.29	0.50	0.45	0.40	0.54	0.73	0.47	0.50
Last year	0.08	0.21	0.08	0.09	0.31	0.39	0.16	0.19
Cocaine prevalence								
Lifetime	0.09	0.16	0.09	0.09	0.24	0.30	0.12	0.15
Last year	0.02	0.03	0.02	0.02	0.05	0.06	0.02	0.03
N	529	102	961	1592	181	108	1266	1555

[a)] NP = non-participation, U = unemployment, E = employment.

Table 2 Participation rates, unemployment rates and wages by lifetime and last year prevalence of cannabis and cocaine[a)]

	Cannabis				Cocaine				Total
Prevalence	Lifetime		Last year		Lifetime		Last year		
	0	1	0	1	0	1	0	1	
Males									
Participation	89.2	87.3	89.8	81.4	89.6	80.8	88.6	78.6	88.2
Unemployment	4.1	11.9	5.8	17.1	6.5	17.3	7.6	21.2	7.9
Wage	5.9	6.0	6.0	5.8	6.0	6.0	6.0	5.6	6.0
Females									
Participation	60.6	75.8	66.3	70.9	66.5	70.6	67.0	59.4	66.7
Unemployment	8.8	10.7	8.4	21.0	9.1	14.8	9.6	15.8	9.7
Wage	5.6	5.7	5.6	5.4	5.6	5.5	5.6	5.7	5.6

[a)] Participation as a % of the relevant population, Unemployment as a % of the labor force, Wage as an average of a scale from 1 to 9.

Table 3 Parameter estimates starting rates cannabis and cocaine[a)]

	Females		Males	
	Cannabis	Cocaine	Cannabis	Cocaine
Primary education	-0.81 (2.3)	-1.70 (2.7)	-0.26 (0.9)	0.12 (0.2)
Secondary education	-0.11 (0.3)	-1.36 (2.2)	-0.09 (0.3)	-0.03 (0.1)
Higher education	0.17 (0.5)	-1.61 (2.7)	-0.30 (1.1)	-0.36 (0.8)
Birthyear	1.17 (10.4)	2.32 (9.1)	1.07 (11.7)	1.74 (8.7)
Year 1994	-0.10 (0.9)	-0.01 (0.0)	-0.11 (1.2)	-0.58 (3.1)
Mass points				
v_1	-6.07 (7.0)	-6.04 (6.2)	-5.08 (11.1)	-6.23 (9.2)
$v_2 - v_1$	-3.78 (19.5)	-6.88 (19.8)	-4.48 (22.0)	-5.72 (20.6)
Probabilities[b)]				
α_1	-2.01 (18.5)		-1.50 (16.9)	
α_2	$-\infty$		$-\infty$	
α_3	-0.92 (9.7)		-0.89 (11.8)	
-Loglikelihood	3277.1		3842.3	
N	1465		1467	

[a)] Note that for reasons of space the parameters representing duration dependence are not reported; t-values in parentheses.

[b)] The probabilities are (%)

	p_1	p_2	p_3	p_4
Females	8.7	0.0	26.0	65.3
Males	13.7	0.0	25.1	61.2

Table 4 Parameter estimates probit and bivariate probit equations cannabis, cocaine and employment[a)]

	Females		Males	
	Cannabis	Cocaine	Cannabis	Cocaine
Drug use period 1				
Constant	0.05 (0.2)	-1.03 (3.0)	0.10 (0.4)	-0.80 (2.4)
Age/10	-0.22 (4.2)	-0.12 (1.6)	-0.17 (3.3)	-0.08 (1.2)
Primary education	-0.04 (0.2)	-0.20 (0.8)	-0.02 (0.1)	-0.13 (0.6)
Secondary education	0.46 (2.6)	0.21 (0.9)	0.47 (2.7)	0.10 (0.5)
Higher education	0.84 (4.9)	0.18 (0.8)	0.68 (4.0)	0.10 (0.5)
Year 1994	0.05 (0.7)	0.11 (1.2)	0.07 (1.1)	0.01 (0.1)
Drug use period 2				
Constant	-1.53 (3.0)	-1.60 (1.7)	-0.77 (2.0)	-1.63 (1.7)
Age/10	-0.21 (2.4)	-0.29 (0.3)	-0.27 (3.6)	-0.32 (1.7)
Primary education	-0.38 (1.1)	-0.29 (0.5)	-0.80 (2.9)	-0.46 (0.9)
Secondary education	-0.25 (0.8)	-0.03 (0.1)	-0.64 (2.4)	-0.48 (1.0)
Higher education	-0.46 (1.4)	-0.39 (0.7)	-0.86 (3.3)	-0.57 (1.2)
Year 1994	-0.15 (1.3)	-0.07 (0.3)	0.11 (1.2)	0.05 (0.3)
δ_c	1.94 (9.6)	2.00 (5.3)	2.12 (14.2)	2.30 (6.5)
Current Employment				
Constant	-0.42 (1.7)	-0.36 (1.4)	0.22 (0.8)	0.13 (0.5)
Age/10	-0.07 (1.4)	-0.08 (1.6)	0.13 (2.3)	0.14 (2.5)
Primary education	0.61 (3.7)	0.61 (3.7)	0.39 (2.2)	0.39 (2.1)
Secondary education	1.07 (6.3)	1.09 (6.4)	0.33 (1.8)	0.28 (1.5)
Higher education	1.29 (7.9)	1.32 (8.0)	0.66 (3.7)	0.59 (3.2)
Year 1994	-0.06 (0.8)	-0.05 (0.8)	-0.10 (1.3)	-0.11 (1.4)
δ_e	0.08 (1.1)	-0.19 (1.6)	-0.36 (4.6)	-0.56 (5.7)
ρ	-0.21 (3.0)	-0.09 (0.6)	-0.26 (4.3)	-0.06 (0.4)
N	1549		1527	

Table 5 Parameter estimates employment and wages[a)]

	Females		Males	
	Employment	Wages	Employment	Wages
γ_0	-0.24 (0.9)	2.17 (3.6)	0.49 (1.9)	3.53 (10.5)
Age/10	-0.04 (0.8)	0.49 (7.0)	0.06 (1.1)	0.56 (8.5)
Primary education	0.75 (4.5)	0.35 (0.8)	0.36 (2.1)	-0.11 (0.5)
Secondary education	1.15 (6.6)	1.14 (2.4)	0.32 (1.9)	0.51 (2.3)
Higher education	1.35 (7.9)	1.61 (3.3)	0.70 (4.2)	0.93 (4.4)
Single	-0.43 (5.4)	-	-0.43 (5.0)	-
Children	-0.46 (5.8)	-	0.23 (2.3)	-
Parttime	-	-1.54 (16.5)	-	-1.31 (11.8)
Year 1994	-0.04 (0.6)	0.54 (5.9)	-0.06 (0.7)	0.36 (4.1)
Cannabis (δ_a)	0.17 (2.1)	0.17 (1.6)	-0.16 (1.8)	-0.01 (0.1)
Cocaine (δ_b)	-0.27 (2.1)	-0.10 (0.6)	-0.34 (3.2)	0.22 (1.7)
ρ	0.12 (0.5)		-0.65 (8.0)	
$-Loglikelihood$	2464.7		2738.5	
N	1465		1467	

[a)] t-values in parentheses

Table 6 Parameter estimates model with unobserved heterogeneity[a)]

	Females		Males	
Labor market	Employment	Wages	Employment	Wages
Age/10	-0.03 (0.5)	0.49 (6.9)	0.08 (1.4)	0.55 (8.3)
Primary education	0.76 (4.4)	0.36 (0.8)	0.36 (2.0)	-0.11 (0.5)
Secondary education	1.16 (6.5)	1.15 (2.5)	0.33 (1.8)	0.51 (2.3)
Higher education	1.36 (7.8)	1.62 (3.3)	0.70 (4.0)	0.93 (4.3)
Single	-0.43 (5.3)	-	-0.42 (4.8)	-
Children	-0.46 (5.7)	-	0.24 (2.3)	-
Year 1994	-0.05 (0.7)	0.54 (5.8)	-0.06 (0.7)	0.36 (3.9)
Parttime	-	-1.55 (16.3)	-	-1.31 (11.6)
Cannabis (δ_a)	0.18 (2.1)	0.17 (0.6)	-0.11 (1.2)	-0..01 (0.1)
Cocaine (δ_b)	0.26 (0.6)	-0.10 (0.6)	0.63 (1.3)	0.38 (1.0)
ρ	0.14 (0.5)		-0.65 (7.6)	
Mass point γ_0	-0.90 (1.6)	2.18 (2.5)	-0.70 (1.1)	3.32 (5.7)
Mass point γ_0^*	0.61 (1.3)	-0.02 (0.0)	1.09 (2.1)	0.22 (0.5)
Starting rates	Cannabis	Cocaine	Cannabis	Cocaine
Primary education	-0.86 (2.4)	-1.76 (2.7)	-0.23 (0.8)	0.12 (0.2)
Secondary education	-0.10 (0.3)	-1.37 (2.3)	-0.10 (0.4)	-0.16 (0.3)
Higher education	0.15 (0.4)	-1.70 (2.8)	-0.29 (1.0)	-0.38 (0.8)
Year 1994	-0.07 (0.6)	0.00 (0.0)	-0.08 (0.8)	-0.57 (3.1)
Birth year	1.14 (10.2)	2.29 (9.1)	1.05 (11.8)	1.72 (8.8)
Mass point v_1	-6.06 (6.6)	-6.00 (6.0)	-5.06 (10.9)	-6.16 (3.1)
Mass point $(v_2 - v_1)$	-3.75 (19.0)	-6.96 (19.6)	-4.47 (21.3)	-5.75 (19.4)
Probability α_1	-1.98 (2.2)		-1.48 (16.8)	
Probability α_2	$-\infty$		$-\infty$	
Probability α_3	-0.90 (9.1)		-0.88 (11.6)	
$-$*Loglikelihood*	5740.6		6577.0	
$-$*LR test* ($\gamma_0^* = 0$)	2.4		7.6	
$-$*LR test* ($\delta_a = \delta_b = 0$)	7.8		6.4	
N	1465		1467	

[a)] t-values in parentheses; the $\chi^2_{0.05}$ critical value for 2 degrees of freedom ($\gamma_0^* = 0$) is 6.0, for 4 degrees of freedom ($\delta_a = \delta_b = 0$) this is 9.5.

Figure 1 Employment rates by age group

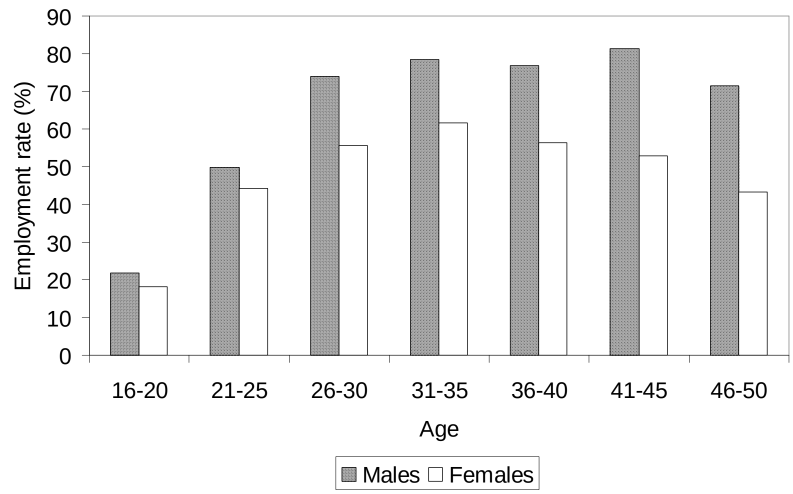

Figure 2 Wages by age group (average scale 1-9)

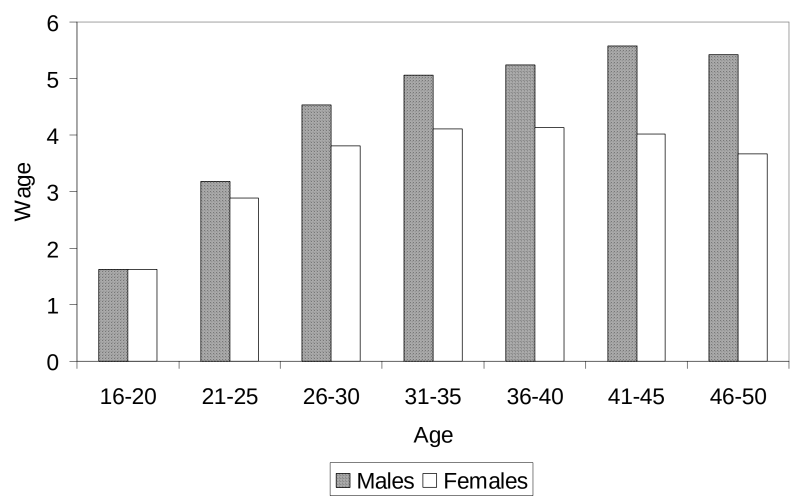

Figure 3 Cumulative starting probabilities cannabis and cocaine (%)

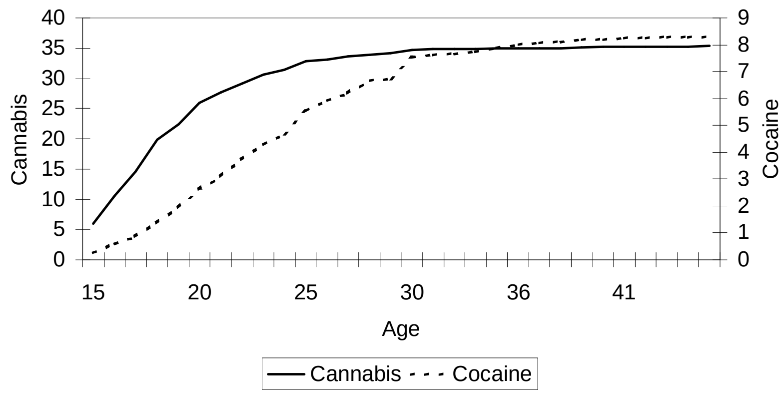

Figure 4 Lifetime prevalence cannabis by age group (%)

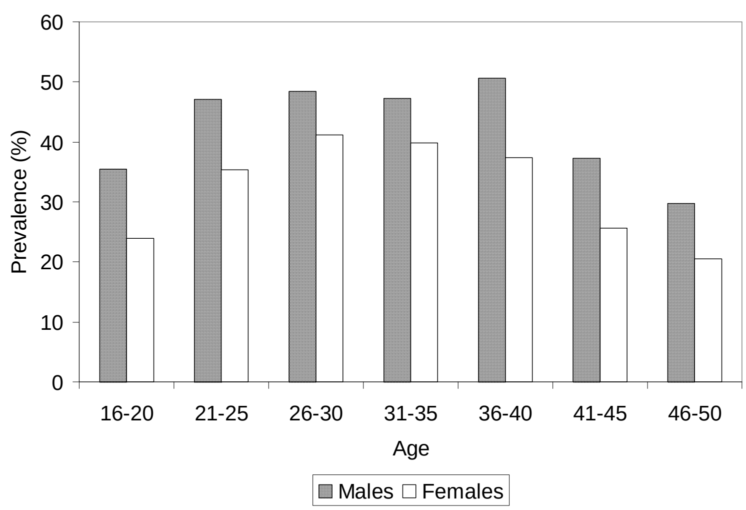

Figure 5 Lifetime prevalence cocaine by age group