A pint a day raises your pay; but smoking blows that gain away

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Very preliminary and extremely incomplete!

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Abstract

This paper studies the wage e¤ects of the use of alcohol and tobacco. The data are from a December 2001 survey in the Netherlands. The analysis shows that for males the use of tobacco has a negative e¤ect on wages while the use of alcohol has a positive e¤ect. The wages of females are not a¤ected by smoking and drinking.

Keywords: drinking, smoking, wages
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1 Introduction

There is a small literature on the relationship between drug use and labor market performance. A lot of studies in this literature focus on the e¤ect of alcohol, there are some studies on the in‡uence of smoking, but there are also studies on the e¤ects of cannabis, cocaine and other illicit drugs. The results in these studies do not reveal a large consensus about the e¤ects of drug use on for example labor supply or wages.

The study by Levine et al. (1997) is a rare exception of a study that investigates the e¤ect of smoking on wages. They …nd that conditional on their observed characteristics workers who smoked earned 4-8% less than nonsmokers. From a theoretical point of view this negative e¤ect of smoking on wages can be attributed to discrimination of smokers, their reduced ability to carry out manual tasks, their increase absenteeism or their high rate of time preference, which induces them to make fewer investments in productivity enhancing human capital. The results are based on OLS-estimates of wage equations, but they also present estimates in which to account for potential unobserved …xed e¤ects by employing sibling data. And they also present panel estimates based on di¤erences in wages changes between workers that quit smoking and workers that continue smoking. Unfortunately, their investigation on the possible nature of the negative wage e¤ect is without results.

On the e¤ect of alcohol more studies have been done. All studies …nd positive wage e¤ects of drinking, although the exact nature of the e¤ect di¤ers. Basically there are two types of results: either drinking has a positive but constant wage e¤ect over some range of use, or there is an inverted U-shape relationship where there is a maximum positive wage e¤ect at some drinking intensity while drinking more or drinking less induces a smaller wage e¤ect. Examples of the …rst type of studies are Berger and Leigh (1988) and Zarkin et al. (1998). Berger and Leigh (1988) …nd that drinkers receive higher wages than non-drinkers. Zarkin et al. (1998) conclude that men who use alcohol over a wide range of consumption levels have 7% higher wages than men who do not drink or are heavy drinkers. The study does not …nd a statistically signi…cant alcohol wage premium for females. Examples of the second type of studies are French and Zarkin (1995), Heien (1996), Hamilton and Hamilton (1997) and MacDonald and Shields (2001). MacDonald and Shields (2001) for example studies the e¤ect of alcohol consumption on occupational attainment in England. As measure of educational attainment the mean hourly wage rate associated with an individual's occupation is used. To account for endogeneity or the e¤ect of unobserved characteristics 2SLS models are estimated with 3 groups of instruments (assumed to a¤ect alcohol consumption but not directly occupational attainment)

that are related to illnesses of the interviewee (diabetes, stomach ulcers and asthma), the parents of the interviewee (whether or not they smoked regularly) and self-assessment about the drinking behavior of the interviewee. The …nd both for OLS and 2SLS estimates that there is a positive association between alcohol consumption and mean occupational wages that appeared to have an inverted-U shape form. The 2SLS estimates indicate an optimal alcohol consumption equivalent to about 2 pints of beer a day for males and about 1.5 per day for females.

Past research on the use of soft and hard drugs in relation to labor supply indicates that there is no consensus in the literature.[1] Kaestner (1994) …nd a negative association between marijuana (cannabis) or cocaine use and the hours of labor supplied by young males. Zarkin et al. (1998) …nd no signi…cant relationship between past month labor supply and the use of cigarettes, alcohol or cocaine in the past month. Although they …nd a signi…cant positive association with past month cannabis use. On drug use and attainment there is a growing body of empirical evidence in the labor economics literature that suggests that once endogeneity is accounted for, one rarely …nds a signi…cant negative relationship between substance abuse and wages. Kaestner (1991) …nds that increased frequency of use of cocaine or marijuana is associated with higher wages. Gill and Michaels (1992) and Register and Williams (1992) …nd very similar results. The results suggest that adolescent alcohol and soft drug use have little or no e¤ect on the earnings of men in their late twenties or thirties, although they do …nd that early hard drug use has a signi…cant negative impact. Papers by MacDonald and Pudney (2000a and 2000b) use data from the British Crime Survey (BCS) to estimate a joint model covering past and current drug use together with unemployment and occupational attainment. They conclude that there is an e¤ect of past hard drug use on current drug use. Past use of soft drugs tends not to be signi…cantly 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. MacDonald and Pudney (2001) is only the same line of research …nding similar results.

The main focus of the current paper is on the wage e¤ects of the use of alcohol and tobacco. We also investigate the wage e¤ects of cannabis and cocaine but here our analysis is limited. In the analysis data are

[1] There are also studies on the relationship between alcohol use and labor supply. See for example MacDonald and Shields (2000), which …nds a positive but inverted-U shape relationship between alcohol consumption and occupational attainment.

used that were collected by means of additional questions addressed to the participants of the CentER-data panel in December 2001.

The paper is set up as follows. Section 2 gives stylized facts about the labor market position and the drug use of the individuals in the panel. Section present the results of several empirical investigations. The intensity of use of tobacco and alcohol is investigated. Furthermore, the results of several wage regressions are presented in which the use of tobacco and alcohol are used as explanatory variables. Section 4 concludes.

2 Data on labor market position and drug use

The data used in the analysis are collected using the panel of households of CentER-data (see the Appendix for details about the data). The gross dataset contains information about 1010 males and 820 females aged 16 years and older. Table 1 shows the labor market position of these individuals distinguished by age category. Only a few individuals are unemployed. For males that share of unemployed ranges from 1 to 3%, for females this is somewhat higher ranging from 3-7%. Only for the lowest age category 16 to 25 years and for the highest age category over 65 years, males and females are very much alike. For both males and females the age category 16 to 25 years contains a little over 50% of employed workers, while a bit more than 40% is non-participants mainly individuals that are still having full time education. For the highest age category almost all individuals are non-participants. In the age groups 26 to 35 years and 36-45 years almost all males are employed. In the category 46-55 years there are more non-participants, mainly because some of the males retire early or collect disability bene…ts. In the age category 56 to 65 years only 40% of the males in employed, while 60% is non-participants, consisting of early retired workers and workers collecting disability bene…ts. For females the age category 26 to 35 years has the highest employment share, 86%, while 10% of this age category is non-participant. At higher ages the employment share drops substantially to 17% for the age category 56 to 65 years.

Table 2 shows the use of tobacco, alcohol cannabis and cocaine by age group and gender. The indicators shown are life time prevalence (ltp), last year prevalence (lyp) and last month prevalence (lmp). In most studies it is not possible to study past use independently of current use because last month prevalence automatically implies ever use. Therefore here these standard indicators to show the use of drugs are somewhat adjusted. Life time prevalence concerns ever use up to last year, last year prevalence concerns the use last year up to last month, last month prevalence concerns the use during last month. As shown in

Table 2 for males tobacco life time prevalence increases with age. From 45 years onwards at least 85% of the individuals has ever smoked. For females there is an increase up to the age category 46 to 55 years. At higher ages less females have ever smoked, a phenomenon that is clearly a cohort e¤ect. For most age groups last year prevalence is substantially smaller than life time prevalence indicating that many individuals that ever smoked have stopped smoking. Since the di¤erences between last year prevalence and last month prevalence are small not many individuals have stopped recently. Except for the youngest and the oldest there is not much di¤erence between the age groups in terms of last year or last month prevalence of tobacco. For alcohol the three indicators are not very much di¤erent and with the exception of the oldest group of females none of the prevalence indicators is very much di¤erent across age group. Apparently the use of alcohol is a phenomenon that does not di¤er a lot between population groups. With respect to the use of cannabis the highest life time prevalence is in the age group 26-35 years. Above the age of 55 years the use of cannabis is a rare phenomenon. The life time numbers for cannabis re‡ect the combination of age e¤ect and cohort e¤ect. The age e¤ect implies an increase in life time prevalence as individual grow older, the cohort e¤ect concerns the fact that older cohorts did not have the opportunity at low ages to use cannabis for lack of easy supply.[2] For cannabis last year prevalence is substantially smaller that life time prevalence indicating that a lot of individuals experimented with the use of cannabis but most of them have stopped using. Last month prevalence numbers for cannabis are too small to report. For cocaine life time use is rather low ranging up to 5% for males of the age from 36 to 45 years. Last year prevalence and last month prevalence are too small to report.

Apart from the element a calendar time in the use it may also be important to distinguish between regular use and incidental use. A frequently indicator for this is whether an individual that has ever used a particular drug has done this more than 25 times. Table 3 gives an overview of this intensity of use indicator again distinguished by gender and age group. For tobacco the high intensity of use indicator is substantially below the life time prevalence indicating that a lot of individuals have smoked tobacco in the past but not very frequently. For alcohol the high intensity of use indicator is not much di¤erence from the life time prevalence indicating that those that use alcohol do this on a very regular basis. For cannabis and cocaine the number concerning frequent

[2] As Van Ours (2001) shows for most drugs lifetime prevalence increases up to the age of 25. After that age nothing much happens. Individuals that have not started using a particular drug before age 25 are not very likely to do so later on.

use are very small indicating that a lot of cannabis and cocaine users experiment with the use but this experimentation is related to infrequent use. Because of this I do not study the use of cannabis and cocaine in great detail. Below I will only investigate whether life time prevalence or frequent use of cannabis and cocaine a¤ects wages.[3]

Finally, an important indicator of the use of alcohol and tobacco is what individuals indicate as 'normal' use. To illustrate this I use the following …ve categories for tobacco based on what is reported as the number of cigarettes, cigars or pipes the individual 'normally' smokes during a day.: 0, 1-2, 3-10, 11-20, 20+. For alcohol I use eight categories based on what is reported as the number of glasses of alcohol (beer, wine, genever) the individual 'normally' drinks during a period of 30 days i.e. a month.[4]: 0, 1-5, 6-16, 17-31, 32-62, 63-93, 94-124 and 125 or more drinks. In this paper I focus on individuals from 26 to 55 years. Among individuals below this age range as well as among individuals above this age range there are many non-participants. Table 4 shows the distribution of use of tobacco and alcohol distinguished by gender. It appears that about 60% of the males and females in the sample do not smoke anymore or have never smoked. Between males and females there is not a big di¤erence in the distribution of smoking intensity. Of the males 8% smokes more than 20 cigarettes per day, for females this concerns 5% of the sample. Table 4 also indicates that for those that smoke the average number of cigarettes per day is about 13.

For alcohol the di¤erences in use between males and females are larger. Of the males 7% indicates not to drink, while for females this is 16%. On the other hand 40% of the males indicate to drink on average at least one glass per day, while for females only 20% indicates doing this. The average use for those that drink is a little over 1.5 glass of alcohol per day for males, while for females it is a little less that 1 glass of alcohol per day.

3 Alcohol, tobacco and wages

3.1 Starting rate of alcohol and tobacco use

In the study of the use of alcohol and tobacco I begin with starting rates for which I use hazard rate analysis, a technique that is frequently used

[3] Van Ours (2002) is a companion paper that investigates the e¤ect of the use of cannabis and cocaine on the labor supply of inhabitants of Amsterdam in more detail. Van Ours (2001) investigates whether cannabis is a stepping stone for cocaine.

[4] These categories are also used in Zarkin et al. (1998). Another way to interpret these categories is: 0, up to 1 drink per week, from 1 drink per week up to 1 drink every other day, from 1 drink every other day up to 1 drink per day, 1 to 2 drinks per day, 2 to 3 drinks per day, 3 to 4 drinks per day and 4 or more drinks per day.

in the analysis of labor market dynamics. Figure 1 shows the empirical starting rates for the use of alcohol and tobacco. Figure 1a shows that most of the action in terms of starting to smoke is between from age 14 to 19. The peak in the starting rate for females is at age 16, when almost 20% of the females that did not start smoking until then started smoking. For males there are peaks at ages 15, 16 and 18, with a starting rate of also almost 20%. Figure 1b shows that also for drinking most of the action is in the age range from 14 to 19. The dip at age 11 is due to the fact that the (few) individuals that indicated to have started drinking below age 10 are assumed to have started at age 10. For males there is a peak in the starting rate at age 16, when more than 50% that have not started until then start drinking alcohol. For females there are peaks in the starting rates for alcohol use of more than 30% at age 16 and 18.

The starting point in the current analysis is the mixed proportional hazard model with a flexible baseline hazard. Differences between individuals in the rates by which they start using alcohol and tobacco is characterized by the observed characteristics x, the elapsed duration of time they are exposed to potential use and unobserved characteristics. I take age 10 to be the time at which this potential exposure to drugs starts.

The starting rate for alcohol, at time t conditional on observed characteristics x and unobserved characteristics v_a is specified as

$$\mu_a(t \mid x; v_a) = \lambda_a(t) \exp(x'\beta_a + v_a) \tag{1}$$

where $\lambda_a(t)$ represents individual duration dependence and β_a represents a vector of coefficients. I model flexible duration dependence by using a step function:

$$\lambda_a(t) = \exp(\textstyle\sum_k \lambda_{a;k} I_k(t)) \tag{2}$$

where k (= 1,..,10) is a subscript for age-intervals and $I_k(t)$ are time-varying dummy variables that are one in subsequent age-intervals. I distinguish 10 age intervals of which 9 are of 1 year (age 12, 13, 14, .., 19) and the last interval is open: 19+ years. Because I also estimate a constant term, I normalize $\lambda_{a;1} = 0$.

The starting rate for tobacco is modelled in the same way

$$\mu_b(t \mid x; v_b) = \lambda_b(t) \exp(x'\beta_b + v_b) \tag{3}$$

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

$$f_j(t \mid x; v_j) = \mu_j(t \mid x; v_j) \exp(- \int_0^t \mu_j(s \mid x; v_j) ds) \quad \text{for } j = a; b \quad (4)$$

In the current study on drug consumption I also use a bivariate duration approach to establish the possible existence of a gateway e¤ect. Both starting rates are speci…ed as before, but now I take the possible correlation between the unobserved components into account specifying the joint density function of the two durations of non use t_1 and t_2 conditional on x as

$$h(t_1; t_2 \mid x) = \int_u \int_v f_a(t_a \mid x; v_a) f_b(t_b \mid x; v_b) dG(v_a; v_b) \quad (5)$$

I model the joint distribution of unobserved heterogeneity assuming a discrete distribution $G(v_a; v_b)$ where both unobserved components have two points of support with perfect correlation between them:[5]

$$Pr(v_a = v_a^a; v_b = v_b^a) = p$$

$$Pr(v_a = v_a^b; v_b = v_b^b) = 1 - p \quad (6)$$

where p is assumed to have a logit speci…cation: $p = \frac{\exp(\alpha)}{1+\exp(\alpha)}$: For the explanatory variables I use education and religion. The analysis is done separately for males and females. The parameters are estimated using the method of maximum likelihood. The estimation results are shown in Table 5.

For males none of the coe¢cients of the explanatory variables is different from zero at conventional levels of signi…cance. The pattern of duration dependence reveals that the maximum starting rate for tobacco is at age 18, while for alcohol the maximum starting rate is at age 16. Both starting rate have two mass points. For tobacco one of the mass points goes to minus in…nity which indicates that there is a group of men that will never start smoking. For alcohol the second mass point is signi…cantly lower than the …rst mass point.[6] The parameter of the mass point distribution indicates that - conditional on the observed characteristics and the pattern of duration dependence - there is a group of 87% of the men that has positive starting rates for both tobacco and

[5] I also tried more ‡exible speci…cations of the joint distribution of unobserved heterogeneity but could not identify additional points of support.

[6] The Likelihood Ratio test statistic is equal to 17.4, which would be signi…cant at a 1% level and 3 degrees of freedom (the critical $\chi^2_{0:01} = 11:3$). However, note that a formal LR - test is problematic since one of the parameters (p) is not identi…ed under the null hypothesis.

alcohol. The remaining group of 13% of the men has a lower starting rate for alcohol and a zero starting rate for tobacco.

For females education is negatively related to the starting rate for tobacco and positively related to the starting rate of alcohol. Furthermore, catholic and protestant females are less likely to start smoking than females with no religion or a di¤erent religion. Conditional on their observed characteristics, the peak of the female starting rate for tobacco as well as alcohol is at age 16. Conditional on the observed characteristics and the age dependence there is no clear evidence of the presence of unobserved characteristics. The second mass point for the alcohol starting rate is not signi…cantly di¤erent from zero and when ignoring the presence of unobserved heterogeneity the value of the loglikelihood does not change very much.[7]

3.2 Current use of alcohol and tobacco

The empirical analysis continues with an investigation of the determinants of the intensity of current use concerning tobacco and alcohol. The intensity of use is assumed to be dependent of personal characteristics and whether or not an individual started using tobacco or alcohol early on, that is before the age of 16:

$$\ln(y_{ji} + 1) = \bar{}_{j0} + \bar{}_{j1} x_i + \bar{}_{j2} z_{ji} + "_{ji} \qquad \text{for } j = a; b \qquad (7)$$

where the dependent variable is the log of intensity of use (+1) of tobacco (1) or alcohol. The logarithmic speci…cation is used to reduce the in‡uence of outliers and because non-negative use is not possible. Furthermore, i indicates individual, x represents a vector of personal characteristics like age, education, family position and religion, z represents early drug use, $\bar{}$ are parameters of interest and " is an error term.

Although equation (7) is linear the coe¢cient are estimated using maximum likelihood to account for correlation between $"_{ai}$ and $"_{bi}$, where ½ is the correlation coe¢cient.[8] Table 6 shows the estimation results. For males age has a positive e¤ect on tobacco use although the coe¢cient is signi…cant only at the 10% level. This is probably related to a cohort e¤ect. Higher educated males with partners smoke less than their counterparts. The presence of children in the family does not a¤ect the smoking behavior of males. Finally, males that start early, i.e. begin

[7] The formal LR test statistic = 5.6, which would not be di¤erent from zero at a 5%-level of signi…cance.

[8] The introduction of regional dummies or dummies for urbanization are jointly insigni…cant and do not in‡uence the parameter estimates.

smoking before age 16 have a signi…cant higher tobacco use than individuals that start later on (or do not start at all) and religion does not a¤ect smoking behavior. Concerning alcohol use of males only age and early start have a (positive) e¤ect on alcohol use. The correlation between the error terms is signi…cantly positive indicating that those that - conditional on their observed characteristics drink a lot are also likely to smoke a lot.

By and large females have similar determinants. Females smoke more if they are low educated, have a partner in the household or an early start. They drink more at higher age and if they have started early. Catholic and protestant females drink less than females without religion or with other religions, while religion does not a¤ect smoking behavior. Here too there is a positive correlation between the error terms.

3.3 The e¤ect on wages: OLS and IV

To investigate the e¤ect of the use of alcohol and tobacco on wages I use a restricted dataset of which the main characteristics are also shown in the Appendix. The hourly wage is calculated as the ratio between monthly personal income (as opposed to family income) and monthly number of hours based on the number of hours the worker indicated to work during a week. I restricted the sample to individuals indicating to work between 10 and 60 hours per week.[9] Furthermore, I only used information about individuals for which the hourly wage was at least 10 guilders.[10] The wage equations are speci…ed as:

$$\ln(w_i) = \beta_0 + \beta_1 x_i + \beta_2 y_{1i} + \beta_3 y_{2i} + v_i \qquad (8)$$

where w represents hourly wage, x represents personal characteristics (age and education) and y_1 and y_2 are indicator of the intensity of tobacco and alcohol use. Furthermore, v is an error term of which I initially assume that it is i.i.d. and β are parameters of interest.

I started with estimates in which the indicator of tobacco and alcohol use was speci…ed as a grouped variable according to the speci…cation used in Table 4. The estimation results are shown in Table 7. It appear that age has a positive e¤ect on the wages of both males and females. For every year they grow older male wage increase with 1.3%, while females experience a wage increase of 0.7% with every year they grow older. Education also has a signi…cant e¤ect on the wages of males and females. High educated individuals for example earn about 36% more than individuals without education. Tobacco use has a negative e¤ect

[9] One individual indicated to work 120 hours per week.

[10] A guilder is equivalent 0.44 Euro.

on the hourly wage rate of males, although only for the category 3 to 10 cigarettes per day this effect is significant from zero. For this category the hourly wage is about 12% lower than it is for non-smokers. Alcohol use has a positive effect on the male wage rate, although for the category 1-5 glasses per month and more than 120 glasses per month the effect does not differ significantly from zero. The peak of the effect is for the category 61-90 glasses per month, which has a wage that is about 27% higher than wages on non-drinkers.

From Table 7 I conclude that for males wages are affected by both smoking and drinking while for females this does not seem to be the case.[11] Therefore, I restrict the additional analysis to males.[12] From Table 7 it seems as if the effect of both alcohol and tobacco on the wages of males is nonlinear. To investigate this in more detail I distinguish two specification of drug use: one with a continuous specification, the other as a dummy variable.

The upper part of Table 8 reports the estimation results for wage equations in which tobacco use and alcohol use are specified as continuous variables: $\tilde{y}_{1i} = \ln(y_{1i} + 1)$; $\tilde{y}_{2i} = \ln(y_{2i} + 1)$: In other words the dependent variables in (1) are the determinants in (2). OLS-estimates are presented in the first column of the upper part of Table 8. The coefficients of age and education are almost the same as those in Table 7. Tobacco use has a significant negative effect and alcohol use has a significant positive effect on the hourly wage of males.

To account for possible selection bias due to the fact that not every individual in the sample has a job I added Heckman's sample selection term but did not find a significant parameter connected to this term. Another problem that is frequently dealt with in the literature on the relationship between drugs and wages is endogeneity of drug use. Sofar, the assumption is that recent alcohol and tobacco consumption is a good indicator of past smoking and drinking behavior. The positive wage effect of moderate drinking is sometimes related to better job performance, while moderate and heavy smoking is related to worse job performance. However, if there are unobserved characteristics that affect both drug use and wages OLS-estimates are biased. In search for a instrumental variable, i.e. a variable that affects drug use but does not directly affect wages, I use the estimation results presented in Table 6. From this ta-

[11] I also investigated to what extent lifetime prevalence of cannabis or cocaine affects hourly wages. Lifetime prevalence of cannabis has a positive effect although the related coefficient is not significant (t-value for males = 0.6, t-value for females = 0.4). For cocaine life time prevalence I found a negative effect which is not significant either (absolute t-value for males 0.8, for females 0.9).

[12] I did perform for females similar analyses as described below for males. However, in none of the cases the relevant coefficients were significantly different from zero.

ble it appeared that 'partner' and 'early start' a¤ect both tobacco use and alcohol use. Since it is not very likely that these variable directly a¤ect the wage rate they can be used as instruments for alcohol use and tobacco use. The second column of Table 8 presents 2SLS estimates. It appears that after accounting for potential endogeneity tobacco use still has a negative e¤ect on wages while alcohol use still has a positive e¤ect. In the third column 3SLS estimates are presented in which wage rate, tobacco use and alcohol use are the dependent variables. Again tobacco use has a negative e¤ect and alcohol use has a positive e¤ect. Note that the size of the e¤ects is substantially larger after taking possible endogeneity into account.

The lower part of Table 8 concerns wage equations where tobacco use and alcohol use are speci…ed as dummy variables: $\tilde{y}_{1i} = I(y_{1i} > 2)$; $\tilde{y}_{2i} = I(6 < y_{2i} < 125)$: The OLS-estimates show that males that smoke more than 2 cigarettes per day have an hourly wage that is about 6% lower than that of non-smokers or light smokers. Moderate to medium drinkers have a wage that is about 8% higher than the wage of non-drinkers or heavy drinkers. The 2SLS-estimate and the 3SLS-estimate do not change this result.[13] In the 2SLS estimate smoking more than 2 cigarettes per day lowers the wage with 21%, while drinking moderately increase the wage with 47%.

3.4 Sensitivity analysis

When accounting for possible endogeneity of drug use the main problem of the analysis is to …nd good instrumental variables. The analysis in the previous subsection shows that after accounting for endogeneity of drug use the in‡uence of tobacco use on wages becomes substantially more negative while the in‡uence of alcohol use on wages becomes substantially more positive. This could imply that there are unobserved characteristics that have a positive e¤ect on the wage rate as well as a positive e¤ect on tobacco use and a negative e¤ect on moderate drinking.

To investigate the potential endogeneity of drug use more extensively I used an alternative approach where I combine the information derived from estimating starting rates with estimates of wage equations. I re-specify the wage equation as

$$\ln(w_i) = \gamma_0 + \gamma_0^{\ast} + \gamma_1 x_i + \gamma_2 \tilde{y}_{1i} + \gamma_3 \tilde{y}_{2i} + v_i \qquad (9)$$

where $\gamma_0^{\ast}$ is an additional constant in the wage equation. If $\gamma_0^{\ast} \neq 0$, this indicates that also concerning wage formation there is unobserved het-

[13] Note that the dummy-variables are represented by a linear probability model in both the 2SLS and 3SLS estimates. I investigate whether the size of the e¤ects was related to the educational level but found no evidence of this.

erogeneity. When estimating equation (9) separately it is not possible to identify $\circ^{\square}_{0}$. However, in combination with the starting rate analysis, where it was possible to identify a distribution of unobserved heterogeneity it is also possible to identify $\circ^{\square}_{0}$. The estimation results are shown in Table 9. As shown the second mass point in the wage equations is signi…cantly di¤erent from zero. Also, the LR-statistic for both models is signi…cant at a 1% level.[14] The estimated e¤ects of alcohol and tobacco on the wage are also di¤erent from the OLS-estimates but not as much as when using 2SLS.

4 Conclusions

This paper deals with the e¤ects of the use of tobacco and alcohol on wages. The data are from a December 2001 survey in the Netherlands. From the analysis it appears that the wages of females are not a¤ected by smoking and drinking. For males the use of tobacco has a negative e¤ect on wages while the use of alcohol has a positive e¤ect. For tobacco the negative e¤ect appears for those individuals that smoke more than 2 cigarettes per day. The size of the e¤ect is independent of the intensity of smoking. The positive e¤ect of alcohol use is present for moderate drinkers. Individuals that abstain from the use of alcohol or individuals that drink a lot have a lower wage that moderate drinkers. The size of the wage e¤ect depends on the estimation method. When estimated with OLS the non-smokers or light smokers earn 6% more than moderate or heavy smokers. In this case moderate alcohol users earn 8% more than non-drinkers or heavy drinkers. When estimated with 2SLS non-smokers or light smokers earn 21% more than moderate or heavy smokers, while moderate alcohol consumers earn 46% more than abstainers and heavy drinkers. However, when using an alternative method to account for possible joint determinants of the use of alcohol and tobacco and the level of the wage I …nd that moderate alcohol users earn 7% more than non-drinkers or heavy drinkers while non-smokers or light smokers earn 9% less than heavy smokers. All in all, it seems fair to see that moderate alcohol use increase the wage, but smoking except for light smoking takes away that alcohol induced wage gain.

[14] The critical $\hat{A}^{2}_{0:01}$ for 1 degree of freedom is 6.63. The LR-test statistic for $\circ^{\square}_{0} = 0$ under (1) equals 6.86, and under (2) equals 7.14.

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5 Appendix Information about the data

5.1 CentER-data panel

The CentERpanel is an Internet-based telepanel consisting of some 2000 households in the Netherlands. Every week, the panel members …ll in a questionnaire on the Internet, while being at home. The CentERpanel is representative of the Dutch population in terms of age, sex, religion, education, region, and province. The data on the use of alcohol, tobacco, cannabis and cocaine were collected in the week before Christmas 2001. The questions about drug use are questions typically asked like life time prevalence, last year prevalence, last month prevalence, frequency of use ever, normal current use. The data about the personal characteristics and labor market position were drawn from the available information about the panel members.

5.2 De…nition of variables

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.
- Children: Dummy variable with a value of 1 if the individual has children and a value of 0 otherwise.
- Partner: Dummy variable with a value of 1 if the individual has a partner and a value of 0 otherwise.
- Catholic: Dummy variable with a value of 1 if the individual indicates to be catholic and a value of 0 otherwise.

- Protestant: Dummy variable with a value of 1 if the individual indicates to be protestant and a value of 0 otherwise.
- Early start tobacco (alcohol) use: Dummy variable with a value of 1 if the individual indicated to have started using tobacco (alcohol) before the age of 16.
- Intensity of tobacco use: number of cigarettes, cigars or pipes the individual 'normally' smokes during a day.
- Intensity of alcohol use: number of glasses of alcohol (beer, wine, genever) the individual 'normally' drinks during a month.
- Life time prevalence: based on the question: did you ever use (tobacco, alcohol, cannabis, cocaine) up to last year?
- Last year prevalence: based on the question: did you use (tobacco, alcohol, cannabis, cocaine) last year (up to last month)?
- Last month prevalence: based on the question: did you use (tobacco, alcohol, cannabis, cocaine) last month?
- Hourly wage calculated as the individual gross monthly income divided by the monthly hours of work (= weekly hours of work *13/3)

5.3 Mean, minimum and maximum

Table A1 General characteristics of the full dataset

	Males				Females			
	Mean	Min	Max	N	Mean	Min	Max	N
Age	48.5	16	86	1010	44.5	16	86	820
Education								
Primary	0.19	0	1	1010	0.25	0	1	820
Secondary	0.35	0	1	1010	0.37	0	1	820
Higher	0.41	0	1	1010	0.29	0	1	820
Family								
Children	0.38	0	1	1010	0.44	0	1	820
Partner	0.77	0	1	1010	0.76	0	1	820
Religion								
Catholic	0.34	0	1	1010	0.33	0	1	820
Protestant	0.20	0	1	1010	0.21	0	1	820
Drug use								
Early start tobacco	0.50	0	1	740	0.42	0	1	489
Early start alcohol	0.37	0	1	915	0.32	0	1	675
Tobacco use	12.5	1	125	408	13.1	1	40	288
Alcohol use	49.0	1	600	912	26.7	1	600	690
Life time prevalence								
Tobacco	0.76	0	1	1003	0.61	0	1	815
Alcohol	0.98	0	1	1000	0.92	0	1	812
Cannabis	0.21	0	1	997	0.15	0	1	810
Cocaine	0.03	0	1	996	0.02	0	1	810
Last year prevalence								
Tobacco	0.32	0	1	1003	0.29	0	1	815
Alcohol	0.92	0	1	1000	0.84	0	1	812
Cannabis	0.04	0	1	997	0.03	0	1	810
Cocaine	0.00	0	1	996	0.00	0	1	810
Last month prevalence								
Tobacco	0.32	0	1	1003	0.28	0	1	815
Alcohol	0.89	0	1	1000	0.77	0	1	812
Cannabis	0.03	0	1	997	0.01	0	1	810
Cocaine	0.00	0	1	996	0.00	0	1	810
Wage								
Hourly wage	69.0	0	2163.5	706	33.6	0	757.2	606

Table A2 General characteristics of the dataset used in the wage regressions

	Males				Females			
	Mean	Min	Max	N	Mean	Min	Max	N
Age	41.4	26	55	508	38.5	26	55	336
Education								
Primary	0.17	0	1	508	0.14	0	1	336
Secondary	0.38	0	1	508	0.42	0	1	336
Higher	0.42	0	1	508	0.42	0	1	336
Family								
Children	0.54	0	1	508	0.49	0	1	336
Partner	0.75	0	1	508	0.72	0	1	336
Religion								
Catholic	0.30	0	1	508	0.30	0	1	336
Protestant	0.18	0	1	508	0.17	0	1	336
Drug use								
Early start tobacco[a)]	0.52	0	1	355	0.44	0	1	201
Early start alcohol[a)]	0.47	0	1	462	0.40	0	1	285
Tobacco use[b)]	11.9	1	45	211	13.1	1	40	119
Alcohol use[b)]	45.5	1	600	474	26.6	1	600	287
Wage								
Hourly wage	33.4	14.4	89.6	508	29.0	11.0	73.4	336

[a)] Conditional on life time prevalence = 1
[b)] Conditional on use > 0

Table 1 Labor market situation by age category and gender

Males	Employed (%)	Unemployed (%)	Non-participants (%)	Total (%)	Total (Number)
16-25 yrs	54	3	43	100	37
26-35 yrs	95	2	3	100	168
36-45 yrs	96	2	2	100	255
46-55 yrs	88	3	9	100	236
56-65 yrs	39	2	59	100	150
65+ yrs	2	1	97	100	164
Total	69	2	29	100	1010
Females					
16-25 yrs	53	6	41	100	51
26-35 yrs	86	4	10	100	203
36-45 yrs	74	3	23	100	221
46-55 yrs	65	7	28	100	158
56-65 yrs	17	0	83	100	99
65+ yrs	2	0	98	100	88
Total	59	3	37	100	820

Table 2 The use of tobacco, alcohol, cannabis and cocaine by age group and gender (% of total)[a)]

	Tobacco			Alcohol			Cannabis		Cocaine
	ltp	lyp	lmp	ltp	lyp	lmp	ltp	lyp	ltp
Males									
16-25 yrs	32	30	30	97	97	95	22	5	3
26-35 yrs	57	38	38	96	91	88	37	6	4
36-45 yrs	67	35	33	96	93	89	25	5	5
46-55 yrs	85	39	38	98	93	92	27	5	3
56-65 yrs	85	31	31	99	95	93	8	1	1
65+ yrs	91	30	15	95	87	84	2	1	2
Females									
16-25 yrs	35	24	20	92	92	84	20	10	2
26-35 yrs	55	30	27	90	80	70	23	2	3
36-45 yrs	67	34	33	92	86	79	18	4	3
46-55 yrs	72	31	30	94	86	79	15	3	2
56-65 yrs	59	30	30	94	89	87	2	0	0
65+ yrs	57	24	16	86	77	77	2	0	0

[a)] ltp = life time prevalence ever use up to last year; lyp = last year prevalence use during last year up to last month; lmp = last month prevalence use during last month?

Table 3 Intensity of use (more than 25 times ever; % of total)

Males	Tobacco	Alcohol	Cannabis	Cocaine
16-25 yrs	30	78	5	0
26-35 yrs	49	89	16	1
36-45 yrs	56	89	9	1
46-55 yrs	65	89	10	0
56-65 yrs	61	93	1	0
65+ yrs	65	87	1	0
Females				
16-25 yrs	22	65	4	0
26-35 yrs	44	78	5	1
36-45 yrs	52	79	8	0
46-55 yrs	56	83	2	1
56-65 yrs	44	81	0	0
65+ yrs	38	74	0	0

Table 4 'Normal' use of tobacco and alcohol by males and females; age 26-55 years

	Tobacco			Alcohol	
Nr/day	Males	Females	Nr/month	Males	Females
0	57	63	0	7	16
1-2	11	8	1-5	15	31
3-10	10	9	6-16	18	18
11-20	14	15	17-31	20	15
20+	8	5	32-62	19	11
			63-93	7	4
			94-124	8	3
			124+	6	2
Total (%)	100	100		100	100
Total (number)	659	582		659	582
Average if positive	13.21	13.46		48.78	25.60
Overall average	5.65	7.77		45.15	21.47

Table 5 Starting rates of tobacco and alcohol for males and females; age 26-55 years[a)]

	Males		Females	
	Tobacco	Alcohol	Tobacco	Alcohol
Education				
Primary	-0.13 (0.3)	-0.10 (0.3)	-0.26 (0.7)	0.17 (0.6)
Secondary	-0.55 (1.4)	-0.12 (0.4)	-0.40 (1.2)	0.35 (1.4)
Higher	-0.58 (1.5)	-0.01 (0.0)	-0.61 (1.8)	0.54 (2.0)
Religion				
Catholic	-0.02 (0.1)	-0.09 (0.8)	-0.29 (2.1)	0.01 (0.1)
Protestant	-0.09 (0.5)	-0.14 (0.9)	-0.53 (2.8)	-0.14 (1.0)
Age dependence				
11	0.20 (0.6)	-1.22 (2.6)	0.01 (0.1)	-2.38 (2.2)
12	0.69 (2.1)	0.18 (0.6)	2.09 (3.3)	0.46 (1.1)
13	0.88 (2.7)	0.22 (0.7)	2.33 (3.7)	0.06 (0.1)
14	1.43 (4.7)	1.54 (5.8)	3.03 (4.9)	1.74 (5.0)
15	1.99 (6.6)	2.07 (8.0)	3.24 (5.2)	2.17 (6.4)
16	2.09 (6.6)	2.67 (10.1)	3.54 (5.2)	2.83 (8.4)
17	1.52 (4.3)	2.42 (8.5)	3.34 (5.2)	2.24 (6.3)
18	2.16 (5.8)	2.25 (7.1)	3.27 (4.9)	2.80 (7.9)
19	1.41 (3.4)	1.18 (2.7)	2.18 (3.0)	1.87 (4.5)
¸ 20	-0.40 (1.0)	0.07 (0.2)	0.60 (0.9)	0.38 (1.1)
Mass points				
v^a	-3.25 (8.7)	-3.25 (8.7)	-4.61 (6.7)	-2.38 (2.2)
v^b ¡ v^a	¡ 1	-0.90 (2.0)	¡ 1	-1.17 (0.6)
¡ Loglikelihood	3188.25		2720.70	
¡ Logl: no heterog.	3196.96		2723.51	
N	659		582	

[a)] absolute t-values in parentheses.

Table 6 Estimation results intensity of use of tobacco and alcohol by males and females; age 26-55 years (ML)[a)]

	Males		Females	
	Tobacco	Alcohol	Tobacco	Alcohol
Age	0.012 (1.8)	0.036 (5.0)	0.007 (1.1)	0.042 (5.5)
Education				
Primary	-0.41 (1.6)	-0.07 (0.2)	-0.51 (2.1)	0.39 (1.4)
Secondary	-0.33 (1.3)	-0.02 (0.1)	-0.69 (2.8)	0.40 (1.5)
Higher	-0.55 (2.2)	0.18 (0.6)	-1.11 (4.0)	0.54 (2.0)
Family				
Children	-0.11 (0.9)	-0.08 (0.6)	-0.04 (0.3)	-0.18 (1.4)
Partner	-0.47 (3.3)	-0.09 (0.6)	-0.44 (3.3)	-0.10 (0.7)
Religion				
Catholic	-0.03 (0.3)	-0.04 (0.3)	-0.17 (1.5)	-0.30 (2.2)
Protestant	-0.16 (1.1)	-0.06 (0.3)	0.02 (0.1)	-0.33 (2.1)
Previous use				
Early start	0.55 (4.8)	0.51 (4.4)	0.70 (5.8)	0.78 (6.0)
Constant	1.14 (3.0)	1.36 (3.0)	1.52 (4.0)	0.09 (0.2)
½	0.14 (3.6)		0.20 (4.9)	
¡ Loglikelihood	2217.15		1908.60	
N	659		582	

[a)] Dependent variable is ln(use + 1); absolute t-values in parentheses; the ¾$_u$ and ¾$_v$ are not reported.

Table 7 Estimation results wage regressions for males and females, age 26-55 years; detailed speci…cation use of tobacco and alcohol (OLS)[a)]

	Males	Females
Age	0.013 (7.6)	0.007 (3.3)
Education		
Primary	0.032 (0.4)	0.077 (0.6)
Secondary	0.135 (1.7)	0.139 (1.2)
Higher	0.358 (4.6)	0.363 (3.1)
Tobacco use		
1-2	-0.041 (1.1)	0.056 (0.8)
3-10	-0.118 (3.0)	0.020 (0.4)
11-20	-0.067 (1.6)	-0.054 (1.3)
20+	-0.052 (0.8)	-0.006 (0.1)
Alcohol use		
1-5	0.081 (1.3)	-0.010 (0.2)
6-16	0.152 (2.7)	0.071 (1.4)
17-31	0.112 (1.9)	0.040 (0.6)
32-62	0.141 (2.4)	0.058 (0.9)
63-93	0.266 (4.0)	0.115 (1.4)
94-124	0.166 (2.2)	0.129 (1.1)
124+	0.104 (1.3)	0.259 (1.9)
Constant	2.60 (21.1)	2.81 (19.8)
$\overline{R}^2$	0.292	0.225
N	508	336

[a)] Absolute t-values in parentheses.

Table 8 Estimation results wage regressions males, age 26-55 years (N=508)[a)]

	OLS	2SLS[b)]	3SLS[c)]
Age	0.014 (7.9)	0.011 (4.8)	0.011 (4.7)
Education			
Primary	0.023 (0.3)	-0.010 (0.1)	0.042 (0.5)
Secondary	0.135 (1.7)	0.122 (1.3)	0.156 (2.0)
Higher	0.353 (4.3)	0.284 (2.9)	0.353 (4.1)
Tobacco use[d)]			
No./day	-0.024 (2.2)	-0.126 (2.3)	-0.098 (2.0)
Alcohol use[d)]			
No./month	0.024 (2.5)	0.127 (2.1)	0.127 (2.3)
Constant	2.637 (22.9)	2.544 (16.6)	2.478 (17.6)
$\overline{R}^2$	0.284	0.180	0.200
Age	0.014 (8.0)	0.013 (6.3)	0.013 (5.9)
Education			
Primary	0.015 (0.2)	-0.042 (0.4)	0.013 (0.1)
Secondary	0.126 (1.6)	0.066 (0.7)	0.127 (1.4)
Higher	0.348 (4.3)	0.263 (2.7)	0.329 (3.5)
Tobacco use[e)]			
> 2/day	-0.064 (2.3)	-0.210 (1.6)	-0.235 (2.1)
Alcohol use[e)]			
6-120/month	0.084 (2.9)	0.474 (2.0)	0.559 (2.1)
Constant	2.640 (23.2)	2.500 (13.9)	2.390 (13.3)
$\overline{R}^2$	0.288	0.183	0.167

a) Absolute t-values in parentheses.

b) Instruments used for tobacco use and alcohol use are 'partner', 'early start alcohol use', 'early start tobacco use' and the other exogenous variables.

c) The equation for tobacco use contains a constant and 'age', 'partner', 'higher education', 'early start tobacco use'; the equation for alcohol use contains a constant and 'age', 'higher education', 'early start alcohol use'; the instruments are a constant, the three educational dummies, 'age', 'partner', 'early start alcohol use', 'early start tobacco use'; the parameter estimates of the alcohol use equation and the tobacco use equation are not shown.

d) Ln(use+1) as continuous variable

e) Dummy variable

Table 9 Estimation results interacting wages and starting rates of tobacco and alcohol, age 26-55 years (N=508)[a)]

	(1)		(2)	
Starting rates	Tobacco	Alcohol	Tobacco	Alcohol
Education				
Primary	-0.38 (0.7)	-0.15 (0.4)	-0.37 (0.7)	0.15 (0.4)
Secondary	-0.60 (1.1)	-0.24 (0.6)	-0.59 (1.1)	-0.24 (0.6)
Higher	-0.71 (1.3)	-0.07 (0.2)	-0.70 (1.3)	-0.07 (0.2)
Religion				
Catholic	-0.00 (0.0)	-0.25 (1.7)	-0.00 (0.0)	-0.25 (1.7)
Protestant	-0.07 (0.4)	-0.14 (0.8)	-0.07 (0.4)	-0.14 (0.8)
Age dependence				
11	0.49 (1.1)	-1.47 (2.5)	0.49 (1.1)	-1.47 (2.5)
12	0.93 (2.3)	-0.20 (0.5)	0.93 (2.3)	-0.20 (0.5)
13	1.03 (2.5)	0.28 (0.8)	1.03 (2.5)	0.28 (0.8)
14	1.64 (4.2)	1.39 (4.6)	1.64 (4.2)	1.39 (4.6)
15	2.21 (5.8)	1.98 (6.7)	2.21 (5.8)	1.98 (6.7)
16	2.24 (5.7)	2.57 (8.6)	2.24 (5.7)	2.57 (8.6)
17	1.68 (4.1)	2.40 (7.5)	1.69 (4.1)	2.40 (7.5)
18	2.27 (5.5)	2.13 (5.8)	2.29 (5.5)	2.12 (5.8)
19	1.60 (3.5)	1.00 (1.9)	1.61 (3.5)	0.99 (1.9)
¸ 20	-0.33 (0.8)	0.02 (0.1)	-0.31 (0.8)	0.00 (0.0)
Mass points				
v^a	-3.25 (5.4)	-3.03 (6.8)	-3.25 (5.3)	-3.04 (6.8)
v^b ¡ v^a	¡ 1	-1.17 (2.5)	¡ 1	-1.09 (2.5)
Wages				
Age	0.014 (7.8)		0.014 (8.2)	
Education				
Primary	0.02 (0.3)		0.02 (0.2)	
Secondary	0.14 (1.9)		0.13 (1.8)	
Higher	0.35 (4.7)		0.35 (4.7)	
Tobacco no./day	-0.034 (3.2)		-	
Tobacco >2/day	-		-0.089 (3.1)	
Alcohol no./day	0.019 (1.8)		-	
Alcohol 6-120/month	-		0.070 (2.4)	
Mass points				
°0	2.68 (25.8)		2.68 (25.7)	
°¤0	-0.17 (2.0)		-0.19 (2.5)	
¡ Loglikelihood	2518.35		2516.72	
¡ Logl: no correlation	2521.78		2520.29	
N	508			

Figure 1a Starting rates for smoking

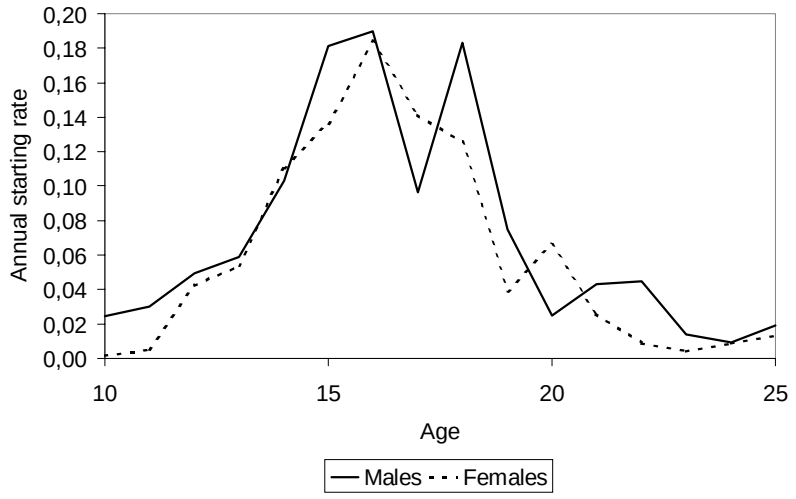

Figure 1b Starting rates for alcohol