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A PINT A DAY RAISES A MAN'S PAY; BUT SMOKING BLOWS THAT GAIN AWAY

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A pint a day raises a man’s pay; but smoking blows that gain away

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Abstract

This paper studies the wage e¤ects of the use of alcohol and tobacco. The analysis based on a recent survey in the Netherlands shows that for males the use of tobacco has a negative wage e¤ect of about 10% while the use of alcohol has a positive wage e¤ect of about the same size. The wages of females are not a¤ected by smoking and drinking.

Keywords: drinking, smoking, wages, earnings regressions
JEL codes: C41, D12, I19

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1 Introduction

There is a small literature on the relationship between drinking, smoking and labor market performance. Most of the studies in this literature focus on the effect of alcohol on wages, some studies are on the influence of smoking on wages and there are also a few studies on the simultaneous effect of smoking and drinking on wages.[1]

The studies based on US, Canadian or Australian data all find positive wage effects of moderate alcohol use.[2] The positive wage effects of drinking are explained through the relationship between drinking and health. Moderate drinkers have a smaller probability to be confronted with coronary heart disease than abstainers or heavy drinkers have. The exact nature of the relationship between alcohol use and wages differs. Basically, there are two types of results. Drinking has a positive but constant wage effect over some range of use. Or there is an inverted U-shape relationship where there is a maximum positive wage effect at some drinking intensity while drinking more or drinking less induces a smaller wage effect. Examples of the first type of studies are Berger and Leigh (1988) and Zarkin et al. (1998). Berger and Leigh (1988) find 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 find a statistically significant 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). French and Zarkin (1995) find that individuals who consume 1.5 to 2.5 alcoholic drinks per day have significantly higher wages than abstainers and heavy drinkers. Heien (1996) finds that at the optimal level of alcohol consumption the wage premium of alcohol is around 50%. Hamilton and Hamilton (1997) find a non-linear effect of alcohol use on wages but only after accounting for endogeneity in the choice of drinking status. MacDonald and Shields (2001) study the effect of alcohol consumption on occupational attainment in England. They find both for OLS and 2SLS estimates that there is a positive association between alcohol consumption and mean occupational wages that appears 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.

[1] There is also research on the use of soft and hard drugs in relation to labor supply. See for an overview of the literature on drugs and labor market performance MacDonald and Pudney (2000).

[2] An exception is Dave and Kaestner (2002) who claim that alcohol use does not adversely affect labor market outcomes.

The study by Levine et al. (1997) is a rare exception of a study that investigates the effect of smoking on wages. They find that conditional on their observed characteristics workers who smoke earn 4-8% less than nonsmokers. From a theoretical point of view this negative effect of smoking on wages can be attributed to discrimination of smokers, their reduced ability to carry out manual tasks, their increased absenteeism or their high rate of time preference, which induces them to make fewer investments in productivity enhancing human capital. The results are partly based on panel estimates focusing on differences in wages changes between workers that quit smoking and workers that continue smoking. Unfortunately, the investigation on the possible nature of the negative wage effect is without results.

Studies that investigate the simultaneous effects of smoking and drinking on wages are Auld (1998) and Lye and Hirschberg (2001). Auld (1998) finds that abstention from alcohol incurs a wage loss of 10% while being a daily smoker is associated with a wage loss of 8%. After accounting for simultaneity he finds that drinking abstention and heavy drinking are associated with an income penalty of 25% to 50%, whereas a daily smoker has a wage of about 30% lower than a non-smoker. Lye and Hirschberg (2001) find a non-linear relationship between alcohol use and wages but only for non-smokers. For smokers no positive wage effect of the use of alcohol is found.

The focus of the current paper is on the simultaneous wage effects of the use of alcohol and tobacco. The analysis uses data from a 2001 survey in the Netherlands. From OLS wage regressions it appears that for males drinking has a wage premium of 13% while smoking has a wage penalty of 6%. The positive wage effect of drinking could be related to better job performance, while smoking is related to worse job performance. However, it could also be that there are unobserved characteristics that affect both smoking/drinking behavior and wages in which case OLS-estimates are biased. The main issue of the current paper is to estimate the effects of smoking and drinking on wages taking into account the effects of possible unobserved heterogeneity. A traditional way is to use instrumental variables where frequently used instruments are religion, prices of alcoholic beverages, diseases, self-assessment or family behavior.[3] In 2SLS and 3SLS estimates I use as instrumental variables whether or not an individual started drinking or smoking before age 16. Then I find that the positive effect of drinking increases to implausibly

[3] MacDonald and Shields (2001) for example use instrumental variables 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.

high values. Such increases in the effect of drinking when applying 2SLS or 3SLS are also found in studies by Zarkin et al. (1998), Heien (1996) and Auld (1998). The size of the effects of alcohol use are very implausible. Apparently it is not easy to find good instrumental variables that affect the choice to drink alcohol but do not directly affect the wage. Therefore, as an alternative to the usual instrumental variable approach I use the analysis of starting rates for alcohol and tobacco to identify the presence of unobserved heterogeneity and relate this to unobserved heterogeneity in the wage equation. My alternative estimates show that alcohol use generates a wage premium for males of about 10% while smoking reduces wages by about 10%. For females I do not find that drinking or smoking affect wages.

The paper is set up as follows. Section 2 gives stylized facts about the labor market position and smoking and drinking of the individuals in the dataset. Section 3 presents parameter estimates of the starting rates for alcohol and tobacco and parameter estimates of the intensity of use of tobacco and alcohol. Section 4 gives the results of several wage regressions in which the use of tobacco and the use of alcohol are explanatory variables. Section 5 concludes.

2 Labor market position, smoking and drinking

The data used in the analysis are collected just before Christmas 2001 (see the Appendix for details about the data). The gross dataset contains information on 1010 males and 820 females aged 16 years and older. Table 1 shows the labor market position of these individuals distinguished by age and gender. Only a few individuals are unemployed. For males the share of unemployed ranges from 1 to 3%, for females this is somewhat higher ranging from 3 to 7%. Only for the lowest age category and the highest age category 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-participant. These are mainly individuals that have 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 benefits. In the age category 56 to 65 years only 40% of the males is employed, while 60% is non-participant, early retired worker or a worker collecting disability benefits. 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 and alcohol by age group and gender. The indicators shown are lifetime prevalence, last year prevalence and last month prevalence. In most studies it is not possible to study past use independently of current use because last month prevalence automatically implies lifetime prevalence. Here these standard indicators are somewhat adjusted. Lifetime 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 lifetime prevalence increases with age. From 45 years onwards at least 85% of the males 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 effect. For most age groups last year prevalence is substantially smaller than lifetime prevalence indicating that many individuals that ever smoked have stopped smoking. Since the differences 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 difference between the age groups in terms of last year or last month prevalence of tobacco. For alcohol the three indicators are not very much different and with the exception of the oldest group of females none of the prevalence indicators is very much different across the age groups. Apparently, the use of alcohol is a phenomenon that does not differ a lot between population groups.

A frequently used indicator to distinguish between regular use and incidental use is whether an individual that has ever used alcohol or tobacco 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 lifetime 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 different from the lifetime prevalence indicating that those that use alcohol do this on a very regular basis.

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 five 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

[4] These categories are also used in Zarkin et al. (1998). Another way to interpret

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 for the age group 26 to 55 years the distribution smoking and drinking 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% indicate 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% indicate 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 than 1 glass of alcohol per day.

3 Alcohol and tobacco use

3.1 Starting rates

In the study of the use of alcohol and tobacco I begin with starting rates. For this I apply hazard rate analysis, a technique that is frequently used in the analysis of labor market dynamics. Figure 1 shows the empirical starting rates. Figure 1a shows that most of the action in terms of starting to smoke is between age 14 and 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 at that age. For males there are peaks at ages 15, 16 and 18, with starting rates of almost 20%. Figure 1b shows that also for starting to drink 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 at that age. For females there are peaks in the alcohol starting rates of more than 30% at age 16 and 18.

The starting point in the current analysis is the mixed proportional hazard model with a ‡exible baseline hazard. Di¤erences between individuals in the rates by which they start using alcohol and tobacco are

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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.

assumed to be related to observed characteristics, the elapsed duration of time they are exposed to potential use and unobserved characteristics. I take age 10 to be the time at which the potential exposure to alcohol and tobacco starts.

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

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

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

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

where k (= 1,..,11) is a subscript for age-interval and $I_k(t)$ are time-varying dummy variables that are one in subsequent age-intervals. I distinguish 11 age intervals of which 10 are of one year (age 10, 11, .., 19) and the last interval is open: $\geq$ 20 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

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

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

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

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

$$h(t_a; t_b \mid x) = \int_u \int_v f_a(t_a \mid x; v_a) f_b(t_b \mid x; v_b) dG(v_a; v_b) \tag{5}$$

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 that are perfectly correlated. This implies that I assume that random effects influence the starting rates, i.e. there are two types of individuals that differ in their inclination towards the use of alcohol and tobacco:[5]

$$\Pr(v_a = v_{1;a}; v_b = v_{1;b}) = p$$

[5] I also tried more flexible specifications of the joint distribution of unobserved heterogeneity but could not identify additional points of support. This is probability due to the fact that smoking without alcohol use rarely occurs.

$$\Pr(v_a = v_{2,a}, v_b = v_{2,b}) = 1 - p \qquad (6)$$

where p is assumed to have a logit specification: $p = \frac{\exp(\alpha)}{1+\exp(\alpha)}$. The explanatory variables are education and religion. The analysis is done separately for males and females and takes account of the fact that some individuals have not started using alcohol or tobacco at the time of the survey but may start in the future, i.e. their durations of non-use are right-censored. The parameters are estimated using the method of maximum likelihood. The estimation results are shown in Table 5.

For males none of the coefficients of the explanatory variables is different from zero at conventional levels of significance. 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 infinity which indicates that there is a group of men that will never start smoking. For alcohol the second mass point is significantly lower than the first 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 representing 87% of the men, which have positive starting rates for both tobacco and alcohol. The remaining group of 13% of the men have a low 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 different type of religion. Conditional on their observed characteristics, the peak of the female starting rates for tobacco and 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 significantly different from the first one and when ignoring the presence of unobserved heterogeneity the value of the loglikelihood does not change very much.[7]

[6] The Likelihood Ratio test statistic comparing a model with and without unobserved heterogeneity is equal to 17.4, which would be significant 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 identified under the null hypothesis.

[7] The formal LR test statistic = 5.6, which would not be different from zero at a 5%-level of significance.

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 depend on personal characteristics and whether or not an individual started using tobacco or alcohol early on, that is before the age of 16:

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

where y is the intensity of use of tobacco or alcohol of person i. The logarithmic specification reduces the influence of outliers, accounts for non-linearity and for the fact that the intensity of use is non-negative. Furthermore, x represents a vector of personal characteristics like age, education, family position and religion, z represents early alcohol or tobacco use, β are parameters of interest and ε is the error term.

Although equation (7) is linear the coefficients are estimated using maximum likelihood to account for correlation between ε_{ai} and ε_{bi}, where ρ is the correlation coefficient.[8] Table 6 shows the estimation results. For males age has a positive effect on tobacco use although the coefficient is significant only at the 10% level. This is probably related to a cohort effect. Higher educated males with partners smoke less than their counterparts do. The presence of children in the family does not affect the smoking behavior of males. Finally, males that start early, i.e. begin smoking before age 16 have a significant higher tobacco use than individuals that start later on (or do not start at all). Religion does not affect smoking behavior. Concerning alcohol use of males only age and early start have a (positive) effect. The correlation between the error terms is significantly positive indicating that conditional on their observed characteristics those that 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 no partner or were an early smoker. They drink more at higher age and if they started drinking early in life. Catholic and Protestant females drink less than females without religion or with a different type of religion, while religion does not affect smoking behavior. Here too there is a positive correlation between the error terms.

[8] Regional dummies or dummies for urbanization are jointly insignificant and do not influence the parameter estimates.

4 Wage effects of tobacco and alcohol use

4.1 OLS parameter estimates

To investigate the effect 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 of personal income and number of working hours. 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] As shown in Table A2 the average hourly wages are about 33 guilders for males and 29 guilders for females. The wage equations are specified as:

$$\ln(w_i) = \gamma_0 + \gamma_1 x_i + \gamma_2 \psi_{ai} + \gamma_3 \psi_{bi} + \varepsilon_i \qquad (8)$$

where w represents hourly wage, x represents personal characteristics (age and education) and ψ_a and ψ_a are indicators of the intensity of tobacco and alcohol use. Furthermore, ε is the error term of which I initially assume that it is i.i.d. and γ is the vector of parameters of interest.

I start with estimates in which the indicator of tobacco and alcohol use are specified using a number of dummy variables representing the categories specified in Table 4.[11] The estimation results are shown in Table 7. It appears that age has a positive effect on the wages of both males and females. For every year they grow older male wage increases with 1.3%, while females experience an annual wage increase of 0.7%. High educated individuals earn about 36% more than individuals without education. Tobacco use has a negative effect 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. For females there is no effect of alcohol or tobacco use. The exception is the category of heavy drinkers that has a wage that is

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

[10] A guilder is equivalent to 0.44 Euro.

[11] 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.

26% higher than the wage of non-drinking females, although the relevant coefficient is only significant at a 10%-level.

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. Furthermore, 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 specifications of use. The first and third column of Table 8 report OLS estimates of wage equations in which tobacco use and alcohol use are specified as continuous variables: $\tilde{y}_{ai} = \ln(y_{ai} + 1)$; $\tilde{y}_{bi} = \ln(y_{bi} + 1)$: In other words the dependent variables in (1) are explanatory variables in (2). 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. The parameter estimates for females wages indicate that tobacco use has no effect, while alcohol use has a positive effect. This latter effect has to do with the large positive wage effect of heavy drinking (see Table 7).

The second and fourth column of Table 8 concern wage equations where tobacco use and alcohol use are specified as dummy variables: $\tilde{y}_{ai} = I(y_{ai} > 0)$; $\tilde{y}_{bi} = I(y_{bi} > 0)$: The parameter estimates show that conditional on their other characteristics males that smoke have an hourly wage that is about 6% lower than that of non-smokers. Alcohol drinkers have a wage that is about 13% higher than the wage of abstainers.[12] Female wages are not affected by alcohol or tobacco use.

4.2 Correcting for unobserved heterogeneity

Although it seems as if drinking has a positive effect on male wages and smoking has a negative effect it cannot be ruled out the there are unobserved determinants that simultaneously affect smoking, drinking and wages. If that is the case it could be that the true causal effects differ from the effects presented in the previous subsection. To account for the effects of unobserved heterogeneity and possible endogeneity of smoking and drinking I used traditional 2SLS and 3SLS estimation procedures. The results presented in Appendix 2 indicate that for females I do not find a significant wage effect. For males the wage effects of alcohol use become implausibly high. As discussed in the introduction this is a phenomenon that occurs in a lot of other studies too.

Apparently, it is difficult to find good instrumental variables. There-

[12] I tried whether smoking 1-2 cigarettes per day or drinking heavily contributed to the explanation of the wage but in neither case I found significant coefficients. I also investigated whether the size of the effects of smoking and drinking is related to the educational level but found no evidence of this.

fore, to investigate the effect of unobserved characteristics I use an alternative approach where I combine the information derived from estimating starting rates to estimate wage equations with unobserved heterogeneity accounted for:

$$\ln(w_{a,i}) = \gamma_0 + \gamma_1 x_i + \gamma_2 \bar{y}_{1i} + \gamma_3 \bar{y}_{2i} + \varepsilon_i \quad (9)$$

$$\ln(w_{b,i}) = \ln(w_{a,i}) + \gamma_0^* \quad (10)$$

where, if $\gamma_0^* \neq 0$, there is unobserved heterogeneity in the wages. In combination with the starting rate analysis, it is possible to identify γ_0^* and relate unobserved heterogeneity in the starting rates to unobserved heterogeneity in the wage equation:

$$\Pr(v_a = v_{1,a}, v_b = v_{1,b}, \gamma_0^* = 0) = p$$

$$\Pr(v_a = v_{2,a}, v_b = v_{2,b}, \gamma_0^* \neq 0) = 1 - p \quad (11)$$

The estimation results shown in Table 9 indicate that the second mass point in the wage equation is significantly smaller than zero.[13] This implies that males that are inclined to drinking and smoking have a higher wage than otherwise similar individuals that do not have a strong inclination to drink alcohol and have a zero starting rate for tobacco use. Therefore, OLS overestimates the positive wage effect of alcohol and underestimates the negative wage effect of tobacco. The parameter estimates in Table 9 under (1) imply that for an average drinker wages are 6.7% above the wage of an otherwise identical abstainer, while an average smoker has a wage 8.7% below the wage of an otherwise identical non-smoker. Due to the logarithmic specification of the use-variable there are decreasing returns to drinking and smoking. An individual that drinks twice the average has a wage bonus of 7.8% while an individual that smokes twice the average faces a wage penalty of 11.9%. The parameter estimates in Table 9 under (2) imply that a drinker has a wage that is 9.8% higher than an otherwise identical non-drinker while a smoker has a wage that is 9.0% lower than an otherwise identical non-smoker.[14] For both estimates it holds that the positive effect of drinking

[13] The LR-statistic for $\gamma_0^* = 0$ is significant at a 1% level in both models. The critical $\chi^2_{0.01}$ for 1 degree of freedom is 6.63. The LR-test statistic for $\gamma_0^* = 0$ under (1) equals 6.56, and under (2) equals 7.86. I also investigated whether I could identify a third mass point in the distribution of unobserved heterogeneity but did not succeed to do so. Note that Table 9 only contains estimates for males. For females I did not find that alcohol use or tobacco use influence the wage.

[14] The coefficient of alcohol use is on the borderline of significance. This has to do with the substantial variation in the wages of males that are mild users of alcohol. If I respecify the dummy for alcohol use to cover the range above 2 drinks per month I find a coefficient of 0.073 with an absolute t-statistic of 2.2.

is about the same as the negative e¤ect of smoking. Or in other words: smoking cancels out the positive wage e¤ects of drinking.

5 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 smoking has a negative e¤ect on wages while drinking has a positive e¤ect. The size of the e¤ect is almost independent of the intensity of smoking or drinking. I use an alternative method to account for possible joint unobserved determinants of the use of alcohol and tobacco and the level of the wage. It appears that there are unobserved characteristics of individuals that cause di¤erences in earnings between smokers and non-smokers and between drinkers and non-drinkers. Ceteris paribus non-drinkers and non-smokers earn less than drinkers and smokers do. This means that with OLS the positive wage e¤ect of drinking is over-estimated while the negative e¤ect of smoking is under-estimated. Taking the e¤ect of unobserved heterogeneity into account I …nd that alcohol users earn about 10% more than non-drinkers while non-smokers earn about 10% less than smokers do. All in all, it seems fair to say that alcohol use increases the wage, but smoking takes that wage gain away.

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6 Appendix 1: Information about the data

6.1 CentER-data data

CentER-data exploits an Internet-based panel consisting of some 2000 households in the Netherlands. Every week, the panel members fill 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 and tobacco were collected in the week before Christmas 2001. The questions about smoking and drinking are questions typically asked like lifetime 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.

6.2 Definition 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.

- lifetime prevalence: based on the question: did you ever use (tobacco, alcohol) up to last year?

- Last year prevalence: based on the question: did you use (tobacco, alcohol) last year (up to last month)?

- Last month prevalence: based on the question: did you use (tobacco, alcohol) last month?

- Hourly wage calculated as the individual gross monthly income divided by the monthly hours of work (= weekly hours of work *13/3)

Tables A1 and A2 present the characteristics of the full dataset and the dataset used in the wage regressions.

7 Appendix 2: 2SLS and 3SLS estimates

In search for instrumental variables, i.e. variables that affect drug use but do not directly affect wages, I use the estimation results presented in Table 6. From this table it appears that 'partner' and 'early start' affect both tobacco use and alcohol use. I assume that these variables do not directly affect the wage rate so they can be used as instruments for alcohol use and tobacco use. The first and third column of Table A3 present 2SLS estimates. It appears that after accounting for potential endogeneity tobacco use has a negative effect on male wages while alcohol use has a positive effect. However, the estimated coefficient for tobacco is 3 times as large as the OLS estimates presented in Table 8 (although insignificantly different from zero), while this is 5 times as large for the effect of alcohol. So, like previous studies I find that 2SLS-estimates generate a huge increase in the estimated effect of alcohol on male wages. Apparently, the instruments I use are not valid. It is possible that contrary to what I assumed there are unobserved characteristics of individuals that influence both their early start of smoking and drinking as well as their wage. For females I do not find that the coefficients for alcohol or tobacco differ significantly from zero. Auld (1998) stresses that it is important to take simultaneity into account. Wage (or rather income) affects the use of alcohol and tobacco as well as the other way around. If alcohol is a normal good and tobacco is an inferior good and they are nevertheless treated as exogenous alcohol will have a positive effect on wages and tobacco a negative effect. To take account of this feedback mechanism I performed 3SLS estimates of which the results are presented in the second and fourth column of Table A3. Again, for males smoking has a negative wage effect and drinking has a positive effect. Note that the size of the effects is again substantially larger than the OLS parameter estimates. Apparently estimating an entire system does not provide more plausible estimates of the wage effects of smoking and drinking than 2SLS does. For females I again find no wage effects of alcohol and tobacco use.[15] Finally, note that Table A3 only presents parameter estimates of wage equations in which tobacco and alcohol use are specified as continuous variables. When specified as dummy variables 2SLS and 3SLS parameter estimates for males are also 5-6 times as large as OLS estimates. For females I again find no significant effects of tobacco and alcohol use.

[15] Table A3 does not presents the parameter estimates for the alcohol use and the tobacco use equation. I find that wages have a positive effect on alcohol use and a negative effect on the use of tobacco. For males the earnings elasticity of alcohol use is approximately 0.9, while the earnings elasticity of tobacco use is about -0.7. For females I find earnings elasticities for alcohol of 1.2 and for tobacco of -2.1.

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
lifetime prevalence								
Tobacco	0.76	0	1	1003	0.61	0	1	815
Alcohol	0.98	0	1	1000	0.92	0	1	812
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
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
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 lifetime prevalence = 1
[b)] Conditional on use > 0

Table A3 Estimation results wage regressions males and females, age 26-55 years (2SLS and 3SLS)[a)]

	Males		Females	
	2SLS[b)]	3SLS[c)]	2SLS[b)]	3SLS[c)]
Age	0.011 (4.8)	0.011 (4.7)	0.007 (2.5)	0.007 (2.4)
Education				
Primary	-0.010 (0.1)	0.055 (0.8)	0.081 (0.6)	0.070 (0.5)
Secondary	0.122 (1.3)	0.137 (2.1)	0.167 (1.2)	0.192 (1.3)
Higher	0.284 (2.9)	0.339 (4.4)	0.415 (2.8)	0.433 (2.7)
Tobacco use[d)]				
No./day	-0.126 (2.3)	-0.070 (1.6)	0.047 (0.8)	0.067 (1.2)
Alcohol use[d)]				
No./month	0.127 (2.1)	0.111 (2.0)	0.010 (0.2)	0.014 (0.3)
Constant	2.544 (16.6)	2.509 (19.0)	2.737 (17.0)	2.705 (16.8)
R^2	0.180	0.200	0.171	0.149

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

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 and alcohol by age group and gender (% of total)[a)]

	Prevalence tobacco			Prevalence alcohol		
	Lifetime	Last year	Last month	Lifetime	Last year	Last month
Males						
16-25 yrs	32	30	30	97	97	95
26-35 yrs	57	38	38	96	91	88
36-45 yrs	67	35	33	96	93	89
46-55 yrs	85	39	38	98	93	92
56-65 yrs	85	31	31	99	95	93
65+ yrs	91	30	15	95	87	84
Females						
16-25 yrs	35	24	20	92	92	84
26-35 yrs	55	30	27	90	80	70
36-45 yrs	67	34	33	92	86	79
46-55 yrs	72	31	30	94	86	79
56-65 yrs	59	30	30	94	89	87
65+ yrs	57	24	16	86	77	77

[a)] Lifetime prevalence ever use up to last year; Last year prevalence use during last year up to last month; Last month prevalence use during last month

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

	Males		Females	
	Tobacco	Alcohol	Tobacco	Alcohol
16-25 yrs	30	78	22	65
26-35 yrs	49	89	44	78
36-45 yrs	56	89	52	79
46-55 yrs	65	89	56	83
56-65 yrs	61	93	44	81
65+ yrs	65	87	38	74

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_1	-3.10 (6.6)	-3.25 (8.7)	-4.61 (6.7)	-2.38 (2.2)
v_2 ¡ v_1	¡ 1	-0.90 (2.0)	¡ 1	-1.17 (0.6)
Heterogeneity				
®	1.88 (3.1)		2.56 (1.6)	
¡ Loglikelihood	3188.25		2720.70	
¡ Logl: ($v_2 = v_1$)	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 (Maximum Likelihood)[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)] The 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 (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 for males and females, age 26-55 years (OLS)[a)]

	Males		Females	
Age	0.014 (7.9)	0.014 (8.0)	0.007 (3.5)	0.008 (4.1)
Education				
Primary	0.023 (0.3)	0.027 (0.3)	0.083 (0.7)	0.087 (0.7)
Secondary	0.135 (1.7)	0.136 (1.6)	0.138 (1.2)	0.148 (1.2)
Higher	0.353 (4.3)	0.360 (4.4)	0.361 (3.1)	0.381 (3.1)
Tobacco use				
No./day[b)]	-0.024 (2.2)	-	-0.009 (0.7)	-
> 0[c)]	-	-0.057 (2.3)	-	0.008 (0.3)
Alcohol use				
No./month[b)]	0.024 (2.5)	-	0.025 (2.5)	-
> 0[c)]	-	0.134 (2.6)	-	0.039 (0.9)
Constant	2.637 (22.9)	2.562 (20.6)	2.790 (20.7)	2.753 (19.5)
$\overline{R}^2$	0.284	0.284	0.195	0.185
N	508		336	

a) Absolute t-values in parentheses.
b) Ln(use+1) as continuous variable
c) Dummy variable

Table 9 Estimation results interacting wages and starting rates of tobacco and alcohol, males 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)	-0.60 (1.1)	-0.24 (0.6)
Higher	-0.71 (1.3)	-0.07 (0.2)	-0.71 (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)
Mass points				
v^a	-3.24 (5.3)	-3.03 (6.8)	-3.23 (5.2)	-3.03 (6.7)
$v^b - v^a$	-1	-1.17 (2.5)	-1	-1.02 (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)		0.14 (1.9)	
Higher	0.35 (4.7)		0.36 (4.9)	
Tobacco no./day[b)]	-0.033 (3.2)		-	
Tobacco use ≥ 0[c)]	-		-0.090 (3.1)	
Alcohol no./day[b)]	0.017 (1.8)		-	
Alcohol use ≥ 0[c)]	-		0.098 (1.7)	
Mass points				
γ_0	2.69 (25.7)		2.65 (22.8)	
γ_0^*	-0.19 (2.4)		-0.20 (2.4)	
Heterogeneity				
α	2.25 (4.5)		2.10 (4.4)	
$-$ Loglikelihood	2518.50		2517.73	
$-$ Logl: ($\gamma_0^* = 0$)	2521.78		2521.66	

a) Absolute t-values in parentheses. To save space the coefficients for age dependence in the starting rates are not reported. These coefficients are almost the same as the ones reported in Table 5.

b) Ln(use+1) as continuous variable

c) Dummy variable

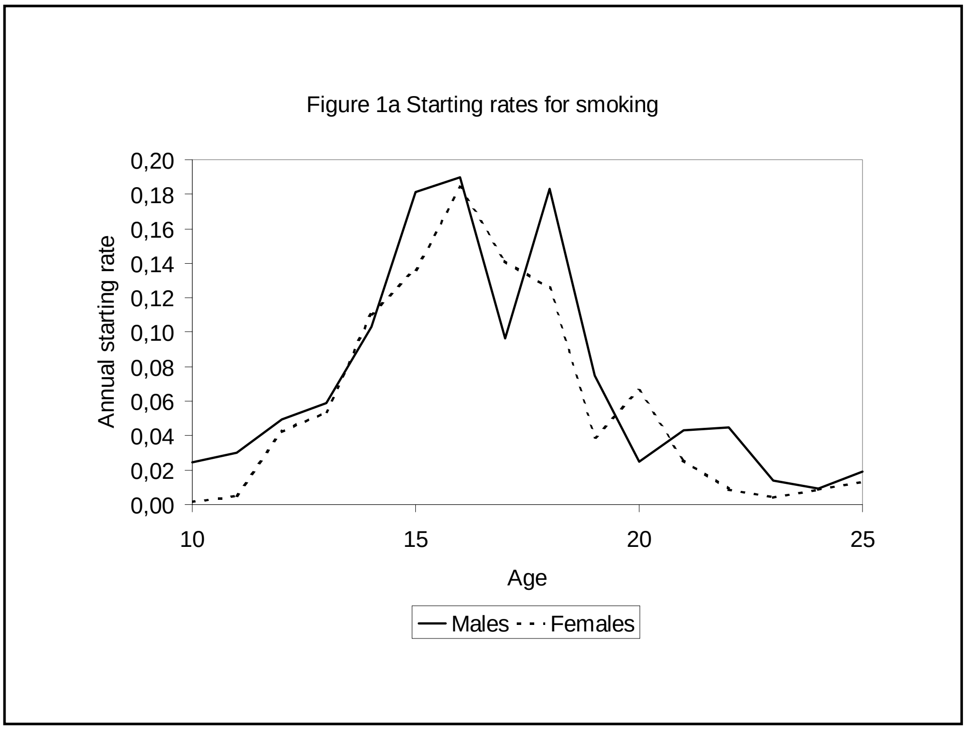
Figure 1a Starting rates for smoking
Annual starting rate
0,20
0,18
0,16
0,14
0,12
0,10
0,08
0,06
0,04
0,02
0,00
10
15
20
25
Age
Males
Females

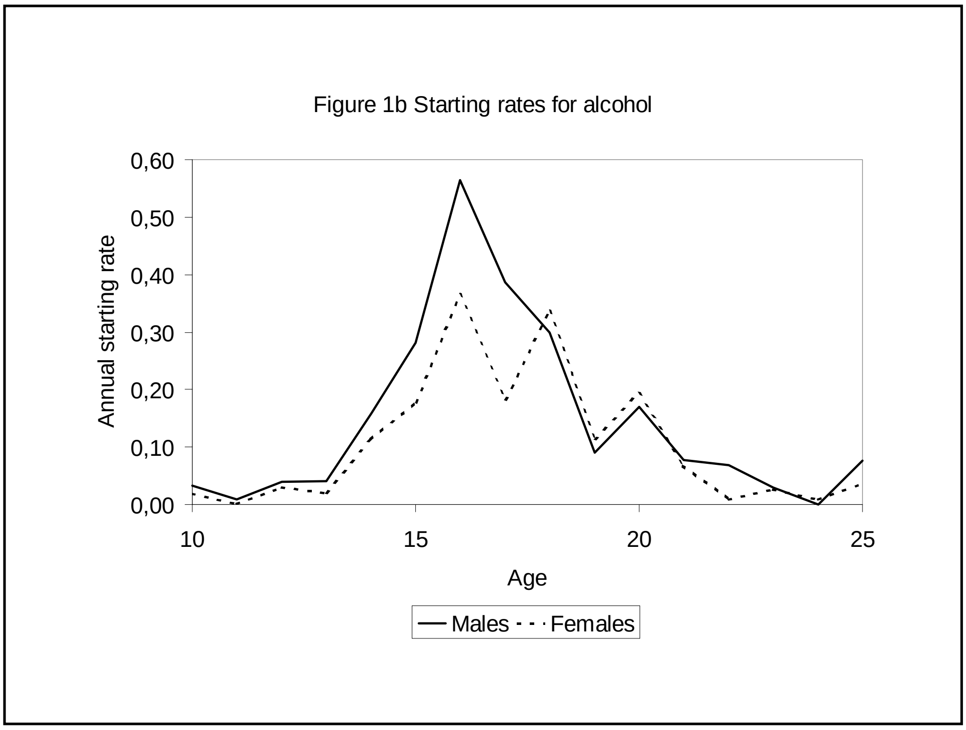
Figure 1b Starting rates for alcohol
Annual starting rate
0,60
0,50
0,40
0,30
0,20
0,10
0,00
10
15
20
25
Age
Males
Females