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**Smoke and Strong Whiskey:
Factors Influencing Female Smoking and
Drinking in Ireland**

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Smoke and Strong Whiskey: Factors Influencing Female Smoking and Drinking in Ireland

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April 2001

Abstract: This paper analyses decisions regarding smoking and drinking for a sample of Irish women. Double-hurdle models are estimated to determine whether decisions to smoke/drink are made independently of how much to smoke/drink. Given the potential complementarities between smoking and drinking a model which allows for the joint determination of smoking and drinking is also estimated. The paper finds that decisions to smoke/drink and how much to smoke/drink are not independent and that decisions to smoke/drink are not made independently of each other.

Keywords: Smoking, Drinking, Double-hurdle, Selection.

JEL Codes: I12, D12, C24, C25.

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Smoke and Strong Whiskey: Factors Influencing Female Smoking and Drinking in Ireland

1. Introduction.

Concern over smoking (and to a lesser extent drinking) has become a major public policy health issue in Ireland in recent years.¹ Such concern has arisen because of the widespread evidence regarding the effect of smoking upon health. It has also presumably been influenced by the evidence which suggests that the downward trend in cigarette consumption per capita levelled off in the 1990s. Particular concern has been expressed with regard to smoking by women. This arises from the fact that the share of tobacco consumption accounted for by women has been rising, with this increase mainly accounted for by younger women. Currently among the 18-34 age group women comprise the majority of smokers. (Mooney, 2000).

It is probably true to say that concern over drinking has not been quite as acute as concern over smoking (although concern over teenage drinking has heightened recently). Nevertheless, as the *National Health Promotion Strategy 2000-2005* document points out, drinking patterns have changed to the extent that the majority of adults now drink and drinking in excess of the weekly recommended intake is substantial and concentrated amongst younger people.

This paper draws upon a recently carried out survey of women's lifetime health needs, *The Saffron Initiative*. This survey contains information on a variety of health issues, including smoking, drinking and lifestyle as well as demographic and education information etc. Using the information in this survey we hope to investigate the factors influencing women's smoking and drinking patterns. As we outline below, we believe that it is also worth investigating the possibility that smoking and drinking decisions are made jointly as opposed to individually.

The remainder of the paper is as follows: in the next section we discuss trends in smoking and drinking in Ireland. We also review both the Irish and international evidence on the health effects of smoking and drinking as well as the existing evidence on the

determinants of tobacco and alcohol consumption. Section 3 discusses the appropriate econometric methodology while section 4 examines factors influencing smoking and drinking when taken separately. In section 5 we model the smoking and drinking decisions jointly, while section 6 offers concluding comments.

2. The Causes and Consequences of Smoking and Drinking: Evidence from Ireland and Abroad

Health Effects of Smoking

Concerns over the potentially adverse effects of cigarette smoking have been expressed since the early part of the twentieth century. By 1930 statistical correlations between cancer and smoking had been established but the breakthrough in terms of public consciousness can probably be dated to 1952 and the publication of an article entitled “Cancer by the Carton” by the *Reader’s Digest* magazine. In 1964 the US Surgeon General released a report titled “Smoking and Health” which concluded that cigarette smoking was causally related to lung cancer in men and that the data for women, although less extensive, pointed in the same direction. Subsequent research has confirmed that, as well as lung cancer, smoking is also implicated in chronic obstructive pulmonary disease (in the form of chronic bronchitis and emphysema), cardiovascular diseases, other forms of cancer (including the oral cavity, pharynx, larynx, oesophagus, pancreas and bladder) and other diseases including cataracts, osteoporosis and periodontal disease (Mooney, 2000). As well as these health risks to the smoker there are also risks for non-smokers via passive smoking. These include an increased risk of lung cancer of about 20-30% (for those with long-term exposure) as well as respiratory illness and asthmatic attacks for infants and children. Smoking in pregnancy increases the risk of miscarriage, reduced birth weight for gestation and perinatal death and cot deaths. Meara (2001) reports that maternal smoking patterns are the single biggest determinant of differing birth-weight by socio-economic status, exercising significantly greater influence than income, education or access to medical facilities. Recent research also suggests that foetuses of women who smoke metabolise cancer-causing agents contained in

¹ For example see Mooney (2000), *Towards a Tobacco Free Society: Report of the Tobacco Free Policy Review Group*.

tobacco.² It also appears that where parents continue to smoke after pregnancy there is an increased rate of cot death, which is one of the main causes of post-neonatal death in the first year of life.

The corollary of the adverse health effects of smoking is the favourable effects for those who quit smoking. Smoking is a very difficult addiction to break, and in most cases it takes three or four attempts before success. For those who do succeed the health benefits are substantial. In the short run (up to one month) breathing, blood flow, smell and taste all show marked improvements. After a year the risk of sudden death from heart attack halves while the death rate from lung cancer falls by 50% after five years. After ten years of quitting the risk of sudden heart attack and stroke has fallen to virtually the same level as someone who never smoked. The importance of quitting is reflected in the fact that the 1990 report of the Surgeon General in the US stated that smoking cessation was the single most important step smokers could take to enhance the length and quality of their lives. Many researchers regard smoking cessation as the “gold standard” of health care effectiveness producing higher quality and length of life at costs well below those of other health care interventions (see Tauras and Chaloupka, 1999).

Evidence also suggests that mortality from tobacco related causes is higher in Ireland than in other EU countries. Age-standardised mortality rates from circulatory system diseases were 38% higher in Ireland than the EU average in 1993, while mortality rates from cancer of the trachea, bronchus and lung were about 18% higher. Mortality rates in general were 23% higher in Ireland than the EU average but since circulatory system diseases and trachea, bronchus and lung cancer account for approximately half of all mortality in Ireland (and about 45% in the EU on average) it is clear that tobacco related illness is a problem with particular relevance here.

Smoking Trends in Ireland

It is probably fair to say that the general perception is that smoking trends in Ireland show a long-term downward trend. However, this downward trend levelled off in the late 1980s and 1990s.³ Data from the World Health Organisation show that the incidence of smoking in Ireland in 1987 was about 32% of the total population. While this fell to 28% by

² Study by Professor Stephen S. Hecht, University of Minnesota: Sponsored by the National Cancer Institute.

³ A similar phenomenon has also been observed in the US. See Tauras and Chaloupka (1999).

1993 it had risen back to 31% by 1998. What is also of interest is the gender composition of smoking. The percentage of Irish women who smoke is amongst the highest in the EU, while male smoking rates are much nearer the median. The gap between male and female smoking rates in Ireland is also very narrow unlike many other EU countries. Latest figures indicate that in 1998 31% of the population smoked cigarettes, 32% of males and 31% of females.⁴ What is perhaps more striking is the age-smoking gradient and how it differs between men and women. For both genders it is downward sloping i.e. the proportion smoking falls as age increases. However, the gradient is much steeper for women. 40% of women aged between 18 and 34 smoke, falling to 18% of the over 55 age group.⁵ For men the figures are 38% and 22% respectively. There is also a social class gradient to be observed in smoking. 28% of women in social classes 1-2 smoke compared to 38% in social classes 5-6. Amongst younger women (aged 18-34) the proportion in social classes 5-6 smoking is 45%. What this reveals is that, overall, the highest proportion of smokers in Ireland is to be found amongst younger females of low income.

Health Effects of Drinking

The health effects of drinking alcohol are more ambiguous. This is because while excessive drinkers experience health problems, moderate drinkers appear to have above average health, above the average of both alcohol abusers and abstainers. The principal factor lying behind this is the influence of alcohol consumption on coronary heart disease (CHD). For many developed countries CHD accounts for a greater proportion of mortality than any other factor. Epidemiological data from at least 20 countries in North America, Europe, Asia and Australia demonstrate a 20-40% lower rate of CHD incidence among drinkers than non-drinkers. Moderate drinkers exhibit lower rates of CHD-related mortality than both heavy drinkers and abstainers (see Renaud et. al, 1993 and Klatsky, 1994).⁶

It is worth noting that there are two classes of non-drinkers, those who have never drunk and those who have drunk, perhaps quite heavily, in the past. These latter individuals

⁴ Approximately a further 7% smoke either pipe or cigars.

⁵ The national Health and Lifestyle Surveys: Department of Health and Children and The Centre for Health Promotion Studies, UCG.

⁶ While definitions of moderate drinking vary among studies the US Department of Agriculture and the US Department of Health and Human Services define moderate drinking as not more than two drinks per day for men and not more than one drink per day for women. A standard drink is 12 grams of pure alcohol, equivalent to one 12 ounce bottle of beer, one 5 ounce glass of wine or 1.5 ounces of distilled spirits.

may have health problems arising from their past drinking. However, even allowing for this, the beneficial effects of moderate drinking appear to hold. For example in a study of 51,000 male health professionals Rimm et al. (1991) found that the relative risk of heart disease fell significantly over a range of alcohol intake from zero to 30 grams per day. Klatsky, Friedman and Siegelau (1990) examined 129,170 members of the Kaiser Permanente Health plan over the 1979 to 1985 period and found that ex drinkers have a higher rate of CHD. They also found that the U shaped relationship between alcohol and health was not due to selective abstinence by individuals at higher risk and that there is a protective effect against CHD of alcohol used in moderation, which appears to be more pronounced for women.

What about the possibility that the role of alcohol is incidental rather than causal? It is possible that health-related lifestyle factors that correlate consistently with drinking levels could account for the association between alcohol and lower risk for CHD. There is evidence that CHD risk is lower for people with higher exercise levels and higher for diets high in saturated fat and cholesterol. The US National Institute on Alcohol Abuse and Alcoholism conclude that the role of exercise in the alcohol-CHD association requires further study but also note that the association is independent of nutritional factors (see National Institute on Alcohol Abuse, 1999).

There is the suggestion that some alcoholic beverages (particularly red wine) afford more CHD protection than others, leading to the conclusion that the association between alcohol and CHD risk may arise from the effects of the beverage ingredient rather than alcohol itself. However, large-scale studies have not found any difference in the incidence of CHD associated with beverage type (see Klatsky et al., 1997). It is possible that a preference for wine over other alcoholic beverages is correlated with a lifestyle which includes other favourable health-related practices. Intuition also suggests that binge drinking is less likely to involve wine than other alcoholic beverages.

Finally, it should be noted that although moderate consumption of alcohol reduces risk from CHD, it may *increase* the risk of other diseases such as cancer, liver cirrhosis, trauma and haemorrhagic stroke (see National Institute on Alcohol Abuse, 1999, for references).

As well as private costs there may also be substantial social costs attached to alcohol consumption. For example, excessive alcohol consumption may cause traffic and other

accidents and may also contribute to violence.⁷ Large social costs are also attributed to lost productivity via lower wages and days sick. However, similar to the ambiguity noted above regarding the relationship between alcohol consumption and health, there is also some ambiguity concerning the relationship between alcohol consumption and wages. For example, Berger and Leigh (1988) and Heien (1996), among others, find a positive effect of alcohol consumption on earnings whereas an opposite result is found by Mullahy and Sindelar (1996) who note that controversy remains even as to the direction of the effects of alcohol on productivity, never mind the magnitude.

Economic Analysis of Smoking and Drinking

Much of the economic analysis of smoking and drinking has concentrated on their role as addictive substances.⁸ There have also been more “conventional” studies. Empirical work can also be divided along the lines of those studies using aggregate time-series data and those using individual micro-data. In many cases the primary role of the study was to estimate the effect of higher taxes in deterring consumption. Of course, this requires some form of price variation, whether over time or by region. The testing of such models as the Becker-Murphy (Becker and Murphy, 1988) model of rational addiction also requires time-series data. The data source in this paper does not have such price variation so our study of the factors affecting alcohol and tobacco consumption will not constitute the estimation of a demand curve. Instead we will focus on the influence of various individual characteristics on the choice to smoke/drink and how much to smoke or drink.

Before moving on to discuss the modelling of tobacco and alcohol consumption, we finish off this section with a very brief review of previous work in Ireland on the topic. Much of the work carried out in Ireland on the subject of alcohol and tobacco consumption has used aggregate time-series data and has been in the context of general studies of demand systems (e.g. see Madden, 1993, Conniffe and Hegarty, 1980 and McCarthy, 1977). By the nature of the data employed these studies cannot address the effect of the various individual characteristics on consumption of tobacco/alcohol. Nor can they distinguish between the different effects of people starting/quitting drinking or smoking and people who already

⁷ For a discussion of the impact of the tax on alcohol on road deaths see Walsh (1987). For a discussion of the impact of alcohol on violent crime see Markowitz (2000).

⁸ For a summary of studies on smoking see Chaloupka and Warner (1999) and for a summary of studies on alcohol see Cook and Moore (1999).

have positive consumption changing their consumption levels. There is reasonable agreement across these studies however that both alcohol and tobacco have price elasticities less than one and that the income elasticity for tobacco is close to zero and possibly negative (this corresponds with the international evidence).

Two examples of studies focusing only on tobacco/alcohol are Conniffe (1995) and Thom (1984). Conniffe tests the Becker-Murphy model on annual time-series data for Ireland. He rejects the model but argues that annual time-series data are not adequate for modelling the rational addiction approach anyway, since a plausible time scale whereby adjustment takes place in response to a price change is likely to be considerably less than a year. Thom compares static and dynamic models of alcohol demand and comes down firmly in favour of dynamic modelling. As stated earlier, none of the Irish studies referred to use individual level micro data. We now turn to outline the range of approaches available given such data.

3. The Econometric Modelling of Tobacco and Alcohol Consumption

In this section we briefly discuss modelling strategies for goods such as tobacco and alcohol and we also discuss our data. Since the relevant methodological issues are practically identical for tobacco and alcohol we will confine the discussion to tobacco alone.

When modelling the consumption of tobacco, one important factor which must be taken into account is the high percentage of zeros which can arise in microeconomic data sets with highly disaggregated information. Such zero observations may occur for three main reasons: firstly, in survey data with short recording periods infrequency of purchase may generate a large percentage of zero consumption.⁹ Second, tobacco may not be a good for some individuals because they are non-smokers. Thirdly, even though a person may be a potential smoker they may not be able to afford the good at current prices and income. Thus the corner solution of zero consumption is the utility-maximising decision for these individuals, given current prices and income. The particular interpretation given to zero observations can have a crucial bearing on the estimation approach adopted.

In this paper we adopt the double-hurdle approach to modelling tobacco consumption.¹⁰ In general this approach assumes that individuals must pass two hurdles before being observed with a positive level of consumption. Both hurdles are the outcome of individual choices: a participation decision and a consumption decision. Lying behind this approach is the idea that there may be certain characteristics of smoking which relate directly to the qualitative distinction between smokers and non-smokers and which are independent of the quantity consumed.

There are three constituents to the double-hurdle approach: observed consumption, the participation equation and the consumption equation. Borrowing from Jones (1989) they can be represented as follows:

$$\text{Observed consumption: } x = d \cdot x^{**}$$

$$\text{Participation equation: } w = \alpha'z + v, \quad d = 1 \text{ if } w > 0, = 0 \text{ otherwise}$$

$$\text{Consumption equation: } x^{**} = \max[0, x^*], \quad x^* = \beta'y + u.$$

Here z and y are the regressors influencing participation and consumption and u and v are additive disturbance terms which are randomly distributed with a bivariate normal distribution. Suppose we allow for the possibility of dependence between the disturbance terms, then if the sample is divided into those with zero consumption (denoted 0) and those with positive consumption (denoted +) the likelihood for the full double-hurdle model is

$$\begin{aligned} L_0 &= \prod_0 [1 - p(d=1) p(x^* > 0 | d=1)] \prod_+ p(d=1) p(x^* > 0 | d=1) g(x^* | x^* > 0, d=1) \\ &= \prod_0 [1 - p(v > -\alpha'z) p(u > -\beta'y | v > -\alpha'z)] \\ &\quad \prod_+ p(v > -\alpha'z) p(u > -\beta'y | v > -\alpha'z) g(x | u > -\beta'y, v > -\alpha'z) \end{aligned}$$

⁹ This is probably best illustrated with semi-durable goods such as clothing, where zero recorded consumption does not imply that the individual/household in question do not wear any clothes!

¹⁰ There are lots of applications of this model to tobacco consumption. For a good example, see Jones (1989).

It is frequently assumed in double-hurdle models that the disturbance terms u and v are independent in which case the model reduces to the Cragg model (Cragg, 1971) with likelihood

$$L1 = \prod_0 [1 - p(v > -\alpha'z)] \prod_+ p(v > -\alpha'z) p(u > -\beta'y) g(x | u > -\beta'y)$$

An alternative simplifying assumption to independence is what is known as first-hurdle dominance i.e. that the participation decision dominates the consumption decision. This implies that zero consumption does not arise from a standard corner solution but instead represents a separate discrete choice. Thus once the first hurdle has been passed, then standard Tobit type censoring (whereby zero, or even negative consumption, could be a utility-maximising choice by someone who has “passed” the participation hurdle) is not relevant. First-hurdle dominance implies that $p(x^* > 0 | d = 1) = 1$ and $g(x^* | x^* > 0, d = 1) = g(x^* | d = 1)$. In this case the likelihood is

$$L2 = \prod_0 [1 - p(v > -\alpha'z)] \prod_+ p(v > -\alpha'z) g(x | v > -\alpha'z)$$

This corresponds to Heckman’s sample selection model. Thus the interpretation placed upon the observed zeros can have a crucial effect upon the likelihood function and consequent estimation.

Finally, if both independence and dominance are assumed then what is known as the case of complete dominance applies. In this situation, the double-hurdle reduces to a probit for participation and ordinary least squares for the consumption equation estimated over those for whom positive consumption is observed with likelihood function

$$L3 = \prod_0 [1 - p(v > -\alpha'z)] \prod_+ p(v > -\alpha'z) g(x)$$

We now describe our data source and explain the reasons behind our chosen estimation strategy. The data set used in this paper is known as the Saffron Survey which was carried out in 1998 by the Centre for Health Economics at University College Dublin.¹¹ The Saffron Survey’s aim was to survey women’s knowledge, understanding and awareness of their lifetime health needs. Much of the focus of the survey was on the issue of hormone replacement therapy¹² but other information regarding health, lifestyle choices and demographics was also collected. For our purposes in this paper the relevant questions

¹¹ I am grateful to Joe Durkan and the Centre for Health Economics for supplying this data.

regarding smoking and drinking were as follows: “Do you currently smoke?”. For those who answer yes to this question there is a follow-up question: “Approximately how many cigarettes do you smoke per day?”. For alcohol consumption the relevant questions are: “In general how often would you say that you take a drink?” and respondents are given a range of seven different replies ranging from “every day” to “never”. Those who answer that they take a drink are then asked how much they usually drink.

Note that the questions are phrased in terms of what typical consumption patterns are, as opposed to what recorded consumption is. While there is a danger that this might give rise to under-reporting (particularly since the goods in question are tobacco and alcohol) it nevertheless suggests that recorded zero consumption of tobacco or alcohol represents a discrete choice, and does not arise from either infrequency of purchase or as a corner solution. In the case of alcohol however, we should bear in mind that someone who classifies themselves as an abstainer may have had heavy alcohol consumption in the past and we might wish to regard them as different from someone who has never consumed alcohol. Unlike the case with tobacco however, we do not have sufficient information to distinguish between these two categories of non-drinkers. Nevertheless, we still believe it is reasonable to assume that first-hurdle dominance applies and so the Heckman sample selection model can be estimated.

In total the sample consisted of 1260 women. However, of that 1260 relevant information was missing for some women. In particular about 100 women did not answer the question regarding weight. Since weight enters into the formula for body mass index¹³, which is a potentially important explanatory variable in our analysis, these observations were dropped. There was also approximately a further 40 women who did not include information on the size of location where their household is situated (which turns out to be a highly significant variable in all specifications) leaving us with an effective sample of 1108 women.¹⁴ The sample was also reweighted to take account of a number of features including the fact that originally women over the age of 45 were oversampled to ensure that there would be an adequate sample of women currently taking Hormone Replacement Therapy.

¹² See Thompson, 2000.

¹³ Body mass index (bmi) is defined as weight (in kg) divided by height (in metres) squared.

¹⁴ In preliminary analysis we created a separate variable called “missing” which included those women who did not give weight information. The variable was not significant in any preliminary regressions suggesting that those observations which were dropped were random and not biased.

Table 1 summarises the relevant variables for the total sample of 1108 women and for smokers and drinkers also. Amongst the features worth noting are that smokers and to a lesser extent drinkers tend to be younger. This probably also lies behind the higher proportions of single women who smoke and drink. However, as we will see below, we must be careful to distinguish between the direct and indirect effects of age. It is perhaps surprising that both smokers and drinkers have a lower recording of non-good health.¹⁵ However, this may reflect the fact that both smokers and drinkers tend to be younger and perhaps less prone to health problems. Smokers tend to have below average educational attainments while drinkers have above average attainments.¹⁶ The higher proportions of drinkers (amongst those who smoke) and smokers (amongst those who drink) also suggest that smoking and drinking may be complementary activities. The last two rows of the table lend some support to this idea as they indicate that smokers tend to drink more than non-smokers. However, it also appears that drinkers smoke less than non-drinkers, though the proportional difference is quite small. This complementarity between smoking and drinking suggests that decisions regarding these activities are possibly made jointly as opposed to separately. We address this issue later in the paper. In the meantime in the next section of the paper we estimate separate models for smoking and drinking.

4. Smoking and Drinking: Separate Models

As explained above, the nature of the information collected in this survey suggests that first-order dominance applies and so the Heckman selection model is appropriate for modelling tobacco and alcohol consumption. Dealing with tobacco consumption first, table 2 gives results for the Heckman model. As ever with selection models issues of identification arise. The approach adopted here has been to take the most general approach and to initially rely upon functional form to achieve identification. We then excluded various subsets of variables from the second stage of the estimation, relying upon a likelihood ratio test to test the validity of the exclusion. The eventual selected specification is that in table 2, and table 3 gives details regarding the tests of the exclusion restrictions. The default is a

¹⁵ Our health data comes in the form of a self-reported measure ranging from excellent to very bad. Following Jones and Yen (1996) we recoded this to a (0,1) variable where anyone reporting excellent and good health was coded as zero, and others were regarded as having “non-good” health and coded one.

single woman, who never exercises, does not work outside the home, does not drink and whose highest education level is primary school. In the level equation, the relevant units are number of cigarettes smoked per day. Given the age profile of smokers referred to above, we include a specification with interaction terms with age for many of the variables.

Examining table 2 we note first of all that complete dominance (i.e. both independence and dominance hold) is rejected with Chi-squares for the Wald test of independent equations of 55.34 and 38.0. Thus the decisions to smoke and how much to smoke are related. The estimated Inverse Mills ratio is positive, large and significant indicating that the unobservables which increase the probability of smoking also exert a strong and positive influence on how much is smoked. We now turn to discuss the results for the level and selection equations. It is worth bearing in mind that the models here have relatively little structure so in some cases the interpretation of coefficients is fairly clear but in other cases it is not. Whether it is accurate to call them reduced form or not depends upon whether one regards variables such as health or education as exogenous. While it is difficult to argue that such variables are exogenous, they are often treated as so in the literature.

We now discuss the specification without the age interaction. Taking the selection equation first, age itself has no effect but having a health problem increases the likelihood of smoking. We must be careful regarding the direction of causality of this variable. While having a health problem may increase the probability of smoking, it is also likely that smoking increases the probability of having a health problem.¹⁷ We note that light exercise increases the probability of smoking as does a lower body mass index. These two coefficients together may reflect the fact that both exercise and smoking are part of a conscious strategy to lower weight on behalf of women. Education has a clear negative impact, with a greater impact for attaining the Leaving Cert or a third level degree than Junior Cert.¹⁸ Drinking also has a positive impact though perhaps curiously being a light

¹⁶ Participants were also asked to put their family income in a range. However, there was quite a high rate of non-response to this question, so we chose not to include it in our analysis. It is likely to be highly correlated with education in any event.

¹⁷ In future work we hope to estimate a model allowing for the simultaneous relationship between self-evaluated health status and smoking.

¹⁸ Students in Ireland typically complete the Junior Certificate at around ages 15-16, while the full cycle of secondary school ends at around 17-18 with the Leaving Certificate.

drinker increases the probability of smoking more than being a frequent drinker.¹⁹ Drinking may act as a proxy for socialising habits which is consistent with the view that social interaction is mainly a qualitative factor influencing the decision to smoke, but not how much to smoke. Increasing townsize also has a positive effect which may be acting as a proxy for certain unobservable lifestyle factors such as socialising patterns or proximity to retail outlets.²⁰ The positive relation between smoking and townsize may also reflect higher stress relating to urban living.

Turning to the decision of how much to smoke, we note that frequent exercise has a negative impact but light exercise has a positive one. Once again there is a strong negative effect for education although this time it only applies to Leaving Cert and Third Level and noticeably once again there is little difference in the size of the coefficient. This is consistent with the view that the risks of becoming a smoker are greatest in the mid to late teens. Thus having a third level degree (compared to Leaving Cert) has little or no extra impact upon smoking patterns, since the period of high risk has already passed. In future work we hope to investigate this issue in more detail. We also note that drinking has no effect and a positive effect once again for townsize. Perhaps curiously the number of children exercise a small but significant effect upon the amount smoked.

As mentioned earlier, concern has been expressed over the prevalence of smoking amongst young women. It may also be the case that the extent to which people discount the costs and benefits of activities such as smoking and drinking will differ according to age. Thus it thus seems reasonable to also include a specification allowing for interaction terms with age. When doing so we observe a positive gradient between smoking and age, though there is some evidence that this effect diminishes at higher ages. This may appear counter-intuitive, given some of the discussion in previous sections. However, in this specification we have allowed for interaction effects between age and other variables in an attempt to isolate the direct and indirect effects of age. In specifications where these interaction terms are not included age has a negative (though not significant) effect. We can conclude that the direct effect of age on its own is positive but taking into account all the indirect effects via

¹⁹ We use the following categories for drinking: frequent drinker = drinks at least 2-3 days per week, moderate drinker = at least 2-3 times per month while light drinker is once a month or less.

²⁰ The townsize variable used here is a categorical variable increasing in size of town. Blaylock and Blisard (1992) found that amongst a sample of low-income American women residence in central cities or suburban areas had a positive impact upon the probability of smoking.

the interaction with other variables in the model its effect is insignificant. From a policy point of view however this could be of crucial importance. Designing a policy initiative purely on the basis of age may be mistaken, if the factors affecting smoking are instead those variables correlated with age as opposed to age itself.

Perhaps it is best to examine those variables whose sign/significance changes when the interaction terms are included. Body mass index now exercises a positive influence on both the probability of smoking and the amount smoked, though the interaction term with age is negative. Thus the impact of BMI on its own is positive (though small) but this impact decreases with age. Drinking now exercises a stronger impact upon both the probability of smoking and the level of smoking but the impact decreases with age. Thus the complementarity between smoking and drinking primarily applies to younger women. The positive impact of children upon both the probability of smoking and the level of smoking also increases but once again these effects diminish with age.

We now turn to the analysis of quitting. Following the question on whether or not people smoke, there is a follow-up question on whether a person has ever smoked. Those who answer that they do not currently smoke but did in the past are defined as quitters. We model quitting via a probit where estimation is confined to those who currently smoke and those who have smoked in the past. Thus someone who has never smoked by definition cannot be a potential quitter. It is interesting to examine whether the factors which influence quitting are similar to those which influence the decision to start smoking. If this is the case then we should expect the coefficients on the quitting probit to be of opposite sign but approximately the same magnitude and significance level as those for the decision to smoke. In the quitting equation in table 3 we have included all the variables included in the first stage of the selection model in table 2 and we have also added two extra variables, the number of cigarettes currently or formerly smoked and the number of years smoking/smoked (obviously these variables could not be included in the Heckman selection model). For a number of variables (light exercise, education and townsize) the coefficients do appear to be of the opposite sign, though approximately the same magnitude. What is perhaps of more interest is the set of variables which have some effect in one equation but not the other. Taking first of all the case where we have no interaction with age, probably the most noticeable discrepancies are the coefficients for marital status. Marital status has no effect upon the probability of smoking but being married or divorced/separated has a

positive impact upon the probability of quitting. This may reflect the situation whereby a smoker marries a non-smoker and decides (or is persuaded to!) quit. This effect is not apparent for widows, perhaps because they were married to smokers who have pre-deceased them. The health variable is also of interest here. As we saw above having a health problem is positively related to the probability of smoking, though the direction of causality may be unclear. It is negatively related (though not significant) to the probability of quitting. This may reflect two offsetting effects. Quitting has a positive effect upon health, yet it is those with a severe health problem who have the highest incentive to quit.

When age interaction terms are included age has a positive effect upon the probability of quitting, yet it also appears to have a positive impact upon the probability of smoking. What perhaps lies behind the solution to this paradox is the fact that for the selection equation in the Heckman model, while the coefficient on age is positive, looking at the interaction terms between age and other variables, it is clear that the impact of many of these variables is affected by age. In general, the effect of age on smoking, via the interaction terms is negative. The interactive terms in the quitting equation are generally insignificant.²¹

The two extra variables included in the quitting equation are also of interest. In the model with no age interaction terms the number of cigarettes smoked has no effect upon the probability of quitting. This may reflect two offsetting factors. Presuming that the decision to quit is made by comparing the costs and benefits of quitting, then it is likely that for those people who smoke a lot, *both* costs and benefits of quitting are high. When the age interaction term is included we observe that the coefficient on number of cigarettes smoked is negative but the coefficient on the interaction term is positive. This may reflect the fact that younger people discount the benefits of quitting to a greater degree than older people. If the full benefits of quitting kick in after about ten to fifteen years, then younger people may feel they can delay the process.

In the model with no age interaction terms the number of years smoking has a negative effect upon the probability of quitting, perhaps reflecting the fact that longtime smokers have a higher dependency upon nicotine. When the age interaction term is included then years smoking on its own has a positive effect upon quitting but the

interaction term with age is negative, indicating that the older you are the less likely you are to quit if you are a longtime smoker. This is somewhat contradictory to the suggested explanations above re the effect of age upon discounting the costs and benefits of quitting but we should also be aware of multicollinearity between age and numbers of years smoking, since obviously it is impossible for young smokers to have been smoking for a very long time.²²

We now turn to estimate similar models for drinking. We follow the same strategy with regard to identification for the Heckman selection model. Table 4 gives our preferred specification. The default is a single woman, who never exercises, does not smoke, does not work outside the home and whose highest education level is primary school. In the level equation the unit of measurement is number of alcohol units per month.

As with smoking the Wald test for the independence of the level and selection equation shows that complete dominance does not hold. What is worthy of note however is that, in contrast to the case of tobacco, the estimated ρ and hence inverse Mills ratio is negative. Thus the unobservable factors that influence people to drink tend to reduce the *amount* that people drink (although the size of the coefficient is quite small). This is not inconsistent with the inverse U shaped relationship between health status and drinking (i.e. moderate drinkers have better health than heavy drinkers or abstainers). Imagine there is some unobservable trait which for want of a better word we could call “obsessive behaviour”. This trait may influence a person to either be complete abstainer from alcohol or to be a heavy drinker. Thus people who practise moderation are likely to be observed as drinkers, but as light drinkers. They may also typically have better health than obsessives. This could simultaneously lead to an estimated selection term which is small in magnitude (and possibly negative), and the inverse U relationship between health status and drinking.

Taking the specification with no age interaction we examine the level equation first. Age and being married or divorced/separated have significant negative effects upon the amount drunk (the marriage coefficient perhaps reflecting different socialising patterns

²¹ In work in progress we are also modelling quitting via duration analysis using retrospective data on quitting. Preliminary results suggest that the effect of age upon quitting is U shaped. Initially it exercises a negative effect which then becomes positive.

²² We also estimated two other models. The first was an ordered probit ranging from non-smoker to quitter to current smoker and the second was a quitting selection model where the first stage was a probit for those who ever smoked and the second stage a probit for quitting. The selection term was insignificant in this model but the results are available on request from the author.

among married as opposed to single women). Third level education has a positive effect as does the number of cigarettes smoked and townsize. In the selection equation age and body mass index have a negative effect while regular exercise has a positive effect, though note that neither body mass index nor regular exercise affect the amount drunk. If we regard regular exercise as a proxy for a health-conscious attitude to life then the results here are consistent with the idea that healthy people drink, but in moderation. Having a medical friend, being divorced/separated, being a smoker and townsize all positively affect the probability of drinking.

Turning now to the models with age interaction and examining the level equation first of all, we note that neither the coefficients on age, nor the interaction terms with age have little effect. The only exception here is the interaction term with number of children (which is positive) while the number of children now exercises a negative effect (it was insignificant in the specification with no age interactions). Thus the number of children you have exercises a negative effect upon the amount you drink, but this effect diminishes as you (and perhaps more importantly the children!) age. Poor health has a strongly negative effect but we must be aware of the possible simultaneity here. Having a health problem may make you drink less, but the inverse U relationship between health and alcohol may also imply that over a range of alcohol consumption, drinking may be good for your health! The education effect once again kicks in at third level. Reflecting the complementarity between smoking and drinking, the number of cigarettes smoked has a positive effect as does townsize. The effect of marital status is the same as in the model without age interaction.

Turning now to the selection equation, the coefficients are very similar to the case without age interaction with the exception of working. In the case without age interaction terms working has no impact on the probability of drinking. We now observe that working on its own has a negative (and almost significant) effect, but this negative effect diminishes with age, perhaps reflecting a different occupational mix for older women. The number of cigarettes smoked exercises a positive effect, although this probably simply reflects the fact of being a smoker. A similar specification was tried using a categorical variable for smoking and it showed that smoking had a positive effect on the probability of drinking but no effect on the amount consumed. Thus being a smoker affects whether you are a drinker, but it is the number of cigarettes you smoke which influences the amount you drink. Finally, townsize also has a positive effect on the probability of drinking.

One noticeable feature of the analysis so far has been the complementarity between smoking and drinking. Drinking affects the probability of smoking, though not the level, while smoking affects both the probability and level of drinking. This suggests that it may be worthwhile to investigate the possibility that smoking and drinking are jointly determined, which we turn to in section 5.

5. Smoking and Drinking: Joint Determination

The analysis in section 4 has indicated strong complementarities between smoking and drinking. There is also extensive evidence, both medical and economic, of these interactions. It is also not just the case that smokers drink and drinkers smoke. It also appears that the heaviest alcohol consumers are also the heaviest smokers. For example, a survey of persons treated for alcoholism and other drug addictions revealed that 222 of 845 subjects had died over a 12 year period. One third of these deaths were attributed to alcohol-related causes and one half were related to smoking (Hurt et. al, 1996). Smoking and drinking may reflect a common addictive personality pattern. Alternatively they may both serve to satisfy what Decker and Schwartz term an “oral drive” (see Decker and Schwartz, 2000). While this is consistent with smokers being more likely to be drinkers it suggests that smoking and drinking are substitutes rather than complements. Smoking and drinking may also serve as mutual cues in the sense that the consumption of one sets the occasion for the consumption of the other e.g. if smoking and drinking are carried out on social occasions it is to be expected that the decisions may be made simultaneously. A final possibility is that the observed relationship between the two may derive from pharmacological factors in the sense that a combined use of alcohol and tobacco may lead to a mutual augmentation of effects (see, for example, Pomerlau, 1995).

Decker and Schwartz (2000) provide evidence on whether the goods are substitutes or complements. They find significant cross-price effects. Specifically, higher alcohol prices decrease smoking participation, while higher cigarette prices increase drinking. They rationalise this along the lines that drinking may be complementary with “social” smoking. Thus higher alcohol prices lead people to stop drinking and since the “situational cue” for smoking is removed, they stop smoking also. However, an increase in the price of cigarettes leads people to stop smoking, inducing greater stress among the now-former smokers, who

turn to alcohol for relief. This scenario is consistent with the evidence presented at the end of section 4. Overall, it seems clear that consumption of the two products is fairly intimately related and so it is worthwhile to explore models whereby smoking and drinking decisions are made jointly.

In table 5 we present estimates of a bivariate probit. Essentially this allows for correlation between the errors in the two separate decisions to smoke and/or drink. The Wald test for correlation between the errors indicates that the model of joint determination is appropriate. For both smoking and drinking the estimated coefficients are quite similar, though significance levels are generally lower compared to the univariate models. For smoking one exception is that having completed junior cert now has no significant effect upon the probability of smoking, and age is also no longer significant. Body mass index is also no longer significant but its interaction term with age retains its significance. For alcohol, very frequent exercise is no longer significant but the other exercise terms are pretty similar to the selection model.

Ideally we would like to estimate a bivariate Heckman model – however such models have not yet been developed to our knowledge. One alternative is to estimate a seemingly unrelated regression (SURE) model for the consumption of tobacco and alcohol and include the inverse Mills ratios from the bivariate probit as additional regressors and the results from such an exercise are presented in table 6. To ensure as much comparability as possible with the univariate selection models estimated earlier we have retained the same set of right-hand side variables as far as is possible. It is not possible however to include the drinking/smoking variables on the right hand side since this renders the variance-covariance matrix singular.

It is also vital to note that our sample size is much reduced, in that we can only estimate this model on women who are both current smokers *and* drinkers. This has a greater impact upon the drinking estimates (since most smokers drink but a substantial proportion of drinkers do not smoke and hence are not in this sample). Thus the results reported here apply only to a subsample of the women analysed in section 4.

Taking the case of smoking first, with no age interaction terms, there are many similarities between the coefficients. The negative effect of third level education on the amount of smoking has increased however, as has the negative impact of working, which is now significant. This may reflect the prevalence of smoking restrictions in the workplace.

Interestingly, Tauras and Chaloupka (1999) note that such restrictions appear to have a greater effect upon women than upon men. In the case where there are age interaction terms, the negative effect of regular exercise is greater in the SURE model, as is the negative effect of being married.

In the case of drinking, one of the most dramatic differences between the models is the greater impact of light exercise on the amount drunk. This coefficient is not significant in the univariate selection models but is highly significant and has a large coefficient in the SURE models (both with and without interaction terms). Taking exercise less than once a month increases weekly alcohol consumption by eleven units, compared to taking no exercise or taking regular exercise. What we have to bear in mind is that this effect is being estimated for smokers only. Thus if you are a smoker then light exercise is correlated with higher alcohol consumption. However for the sample of drinkers as a whole (including both smokers and non-smokers) the effect of light exercise is negligible. Elsewhere the negative impact of being married or divorced/separated on alcohol consumption is greater in the SURE model as is the negative impact of working (although this is only significant in the model without age interaction). Townsize no longer has a positive impact upon the level of drinking in the SURE model, while the interaction term between age and the number of children is no longer statistically significant. Finally, the impact of education is worth noting. For the sample as a whole education has little impact upon drinking except for a small positive effect from third level education. For the sample of smokers and drinkers, higher levels of education appear to have a negative effect upon drinking. The coefficients are quite large but only in the case of the Leaving Cert is it near conventional significance levels.

Finally, the difference in the estimated inverse Mills ratios for smoking and drinking is once again worth noting. The unobservables which increase the probability of smoking also increase the level of smoking (and the coefficient is approximately the same size as that in section 4) but have no significant effect upon the level of drinking. The unobservables which increase the probability of drinking now have a large and significant negative effect on the level of drinking. Recall that in the univariate model for alcohol they had a very small but significant negative effect on the level of drinking. There are two issues worth discussing here. Firstly, the coefficient on the inverse Mills ratio for smoking is relatively unchanged when the sample for the second stage equation is confined to smokers and drinkers as opposed to smokers only. The same can not be said for the coefficient for

drinking. In fact as we have seen the drinking equation in general is far more sensitive to the change to the smaller sample. This reflects the fact that about 87% of smokers drink, while only 35% of drinkers smoke. What is more, the sensitivity of the alcohol equation to the bivariate as opposed to the univariate model indicates that the 35% of drinkers who smoke are not a “representative” 35% of the total drinking population. Given that the proportion of smokers who drink is so high, the drinking smokers are very representative of the smoking population as a whole. Any policy recommendations following from the bivariate analysis must bear this in mind. Thus notwithstanding the significance of the correlation between the error terms in both the bivariate probit and the SURE model it seems preferable that policy implications be drawn from the univariate rather than the bivariate models.

Secondly, as we have seen, the unobserved factors that encourage women to smoke, also encourage them to smoke more. One interpretation of this is that heavy smokers are not qualitatively different from light smokers. However, the coefficients on the inverse Mills ratio for drinking suggests that such a distinction cannot be drawn between moderate and heavy drinkers. The univariate and bivariate models for alcohol indicate that the unobserved factors which encourage women to drink have either a zero or negative effect upon the amount drunk. Given that moderate drinking appears to be good for you, while moderate smoking is still bad for you, it suggests that public policy towards alcohol will need to be more subtle and sophisticated than policy towards smoking.

To conclude this section, in qualitative terms it seems fair to say that there is relatively little difference between the univariate selection models and the SURE model where the inverse Mills ratios from the bivariate probit are included as regressors for smoking. For drinking however, given that the sample for the second stage estimation in the bivariate approach is quite different from that in the univariate approach, caution must be exercised in the interpretation of results.

6. Discussion and Conclusion

This paper has applied double-hurdle models to investigate the factors influencing smoking and drinking for a sample of Irish women. The results confirm that the decisions to smoke/drink are related to the decisions of *how much* to smoke and drink. Amongst the more important factors affecting smoking and drinking were education levels, exercise

patterns and townsize, not to mention the complementarity between smoking and drinking. Following the concern which has been expressed over the age profile of those women believed to be smoking and drinking to excess the role of age was examined in more detail. It was found that care must be taken to distinguish between the direct and indirect effect of age. Some progress was made towards the joint modelling of smoking and drinking. While it was not possible to estimate a full bivariate Heckman selection model, it was found that decisions to smoke/drink are not made independently.

In terms of the policy conclusions which can be drawn from this study, it is unfortunate that the absence of any price variation implies that it is not possible to estimate the effect of the principal policy option, the tax on tobacco/alcohol. We hope to return to this in the future as studies from the US and elsewhere have found that taxation policy can affect both participation and consumption decisions. The importance of education for smoking in particular may reflect the fact that campaigns stressing the ill-effects of tobacco consumption are effective, but it is best to be cautious about attributing a direct role for education on tobacco consumption. As outlined in Meara (2001) the consistent link between education and smoking (and other health habits) may be due to a variety of factors. People with more education may have more health knowledge. In the case of smoking however, it seems difficult to argue that knowledge regarding the adverse health effects of smoking have not diffused widely. Secondly, people with more education may be more efficient users of the stock of health knowledge which is publicly available. Meara finds some evidence that this factor is important. The final link between education and smoking originates with the arguments of Farrell and Fuchs (1986) that there may not be causation between education levels and tobacco consumption, but rather they both reflect low discount rates and a propensity to invest in a number of dimensions of human capital. Meara finds that in her sample of US women this appears to be the most convincing source of the link between education and smoking. The models produced here do not allow us to distinguish between these three competing (and by no means mutually exclusive) causes of the link between education and smoking but it is an area which merits further investigation. The role of townsize may also be worth pursuing as it seems most likely that it is proxying for some other factor. The negative effect of working is also tentative evidence that workplace bans on smoking may be effective.

Finally, the results presented in this paper suggest that it is possible to draw a qualitative distinction between moderate drinkers and heavy drinkers, in a way which is not possible with smokers. Policies to combat substance abuse often take on the same form regardless of the substance in question, but the evidence presented here indicate that a degree of subtlety may be required in framing alcohol policy so as to deter excessive drinking (and its consequent ill effects on health) but not discourage moderate drinking with its beneficial effects. Such subtlety could take the form of differential rates of tax on different beverages if it is believed that certain beverages are associated with heavy drinkers and the degree of substitutability across products is relatively low. Such subtlety does not appear to be required for tobacco.

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Table 1: Summary Statistics for Total Sample, Smokers and Drinkers (standard deviations in italics)

Variable	Mean (Total Sample)	Mean (Smokers Only)	Mean (Drinkers Only)
Age	43.7107 <i>17.58722</i>	38.52536 <i>15.55772</i>	39.56036 <i>15.47441</i>
Weight (kg)	64.60509 <i>10.88295</i>	63.87562 <i>10.86956</i>	64.01015 <i>10.53255</i>
Not Good Health	.184296 <i>.3878938</i>	.1754595 <i>.3809303</i>	.1495021 <i>.3567974</i>
Height (metres)	1.637048 <i>.069628</i>	1.646263 <i>.0731374</i>	1.64179 <i>.0715336</i>
Single	.3199894 <i>.4666746</i>	.3850533 <i>.487338</i>	.3554024 <i>.4789233</i>
Married	.5365284 <i>.4988805</i>	.5095461 <i>.5006589</i>	.5406426 <i>.4986456</i>
Widowed	.0993453 <i>.2992551</i>	.052819 <i>.2240075</i>	.0546711 <i>.227474</i>
Divorced/Separated	.0441369 <i>.2054883</i>	.0525816 <i>.2235315</i>	.049284 <i>.2165907</i>
Primary Education	.2328161 <i>.4228096</i>	.2370001 <i>.4258803</i>	.1628568 <i>.3694573</i>
Junior/Inter Cert	.2707579 <i>.4445443</i>	.3799065 <i>.4860916</i>	.2802717 <i>.4494024</i>
Leaving Cert	.3056061 <i>.4608637</i>	.2243801 <i>.4177994</i>	.3425626 <i>.4748524</i>
Third Level	.1908198 <i>.393118</i>	.1587133 <i>.3659567</i>	.214309 <i>.4105892</i>
Working	.4018932 <i>.4904935</i>	.3825269 <i>.4867334</i>	.4580455 <i>.4985368</i>
Smoker	.3006939 <i>.4587589</i>		.3519775 <i>.4778746</i>
Drinker	.7418714 <i>.4377952</i>	.8683982 <i>.3385645</i>	
Cigarettes per day		14.28767 <i>8.986459</i>	
Units Alcohol per month			11.34031 <i>12.30504</i>
Cigarettes per day (drinkers only)			13.75153 <i>8.565599</i>
Units Alcohol per month (smokers only)		12.76832 <i>12.66476</i>	

Table 2: Max Likelihood Estimates of Heckman Selection Model for Tobacco
(N=1108, 792 Censored)

Variable	No Age Interaction		Including Age Interaction	
	Selection	Level	Selection	Level
Age	-.0073496 <i>.0209972</i>	.3554858 <i>.2432304</i>	.0725028** <i>.0326464</i>	.8543845** <i>.3886029</i>
Age ²	-.000193 <i>.0002196</i>	-.0060295** <i>.0024051</i>	-.0002013 <i>.0002484</i>	-.0037548 <i>.0028745</i>
Health	.1981337** <i>.0910852</i>		.2016711 <i>.2095673</i>	
Exercise 4 times a week	.0430337 <i>.1417342</i>	-2.941686* <i>1.702815</i>	.0788961 <i>.1346458</i>	-1.5886 <i>1.644996</i>
Exercise 2-3 times a week	.053778 <i>.1358494</i>	-1.972403 <i>1.685375</i>	.089084 <i>.1382166</i>	-1.339153 <i>1.74402</i>
Exercise once a week	.4610827*** <i>.1523259</i>	1.250817 <i>1.953329</i>	.504989*** <i>.1572292</i>	2.254283 <i>2.029396</i>
Exercise once a month	.5517169*** <i>.2105467</i>	6.968252** <i>2.741157</i>	.5574036*** <i>.2114939</i>	7.770981** <i>2.893428</i>
Exercise less than once a month	-.05727 <i>.2257259</i>	-1.972725 <i>2.859074</i>	-.0237635 <i>.2206631</i>	-2.24523 <i>2.8316</i>
Body Mass Index (BMI)	-.0261592*** <i>.009975</i>		.0675682* <i>.0398289</i>	.9368441* <i>.5216957</i>
Married	.0043362 <i>.162593</i>	-.6227914 <i>2.00376</i>	-.0630856 <i>.1571226</i>	-2.105432 <i>2.05777</i>
Widowed	-.089705 <i>.2454362</i>	-3.220286 <i>3.267749</i>	-.0271648 <i>.2264375</i>	-2.166821 <i>3.152013</i>
Divorced/Separated	.0020566 <i>.2655058</i>	.3514757 <i>3.340757</i>	-.0780794 <i>.2653121</i>	-1.403807 <i>3.423944</i>
Junior/Inter Cert	-.3598318** <i>.1403958</i>	-2.174294 <i>1.822166</i>	-.3410081** <i>.1334224</i>	-2.47843 <i>1.826195</i>
Leaving Cert	-.9655997*** <i>.1574462</i>	-8.217057*** <i>2.299625</i>	-.9233618*** <i>.1530102</i>	-9.159802*** <i>2.492362</i>
Third Level	-.9021508*** <i>.1756271</i>	-8.579733*** <i>2.650488</i>	-.8981184*** <i>.1759062</i>	-9.087325*** <i>2.791169</i>
Working	-.1190233 <i>.1160498</i>	-1.333345 <i>1.393274</i>	.286052 <i>.2610319</i>	
Medical Friend	.0216434 <i>.0680667</i>		.0340374 <i>.0688457</i>	

Variable	Selection	Level	Selection	Level
Frequent Drinker	.2448196** <i>.1131955</i>		1.535598*** <i>.4854916</i>	11.27936* <i>6.31768</i>
Moderate Drinker	.280611*** <i>.1081357</i>		.7700825* <i>.4219822</i>	2.34937 <i>6.054678</i>
Light Drinker	.4037876*** <i>.1186641</i>		1.279968*** <i>.464709</i>	8.562638 <i>5.670235</i>
Number of Children	.0428386 <i>.0280549</i>	.9768787 <i>.4222101</i>	.2579371** <i>.1036795</i>	3.93673*** <i>1.318695</i>
Townsize	.0526941 <i>.0131416</i>	.5062206 <i>.1624636</i>	.1348512*** <i>.0277644</i>	.590439*** <i>.1658961</i>
Age*Health			-.0004429 <i>.0038753</i>	
Age*BMI			-.0022082*** <i>.0008503</i>	-.0243722** <i>.0119685</i>
Age*Working			-.0110154* <i>.0064073</i>	-.0384732 <i>.0379358</i>
Age*No. of Children			-.0036491** <i>.0017161</i>	-.0540724** <i>.0224646</i>
Age*Frequent Drinker			-.0286186*** <i>.0108291</i>	-.2504321* <i>.1410709</i>
Age*Moderate Drinker			-.0066223 <i>.0086167</i>	-.0063446 <i>.1282456</i>
Age*Light Drinker			-.0153801* <i>.0083492</i>	-.1328961 <i>.1053799</i>
Age*Townsize			-.0019008*** <i>.000491</i>	
ρ	.931492*** <i>.0296966</i>		.9530752*** <i>.0277176</i>	
σ	12.01248*** <i>1.227967</i>		12.16756*** <i>1.410169</i>	
λ	11.18953*** <i>1.452937</i>		11.5966*** <i>1.647338</i>	
Wald Test of Independent Equations	55.34 P-value = 0.0000		38.00 P-value = 0.0000	
LR Test for Excluded Variables	2.544, P-value=0.864		0.798, P-value=0.939	

***=significant at 99%, **=significant at 95%, *=significant at 90%

Table 3: Probit Estimates of Quitting (N=516)

Variable	Not Including Age Interaction	Including Age Interaction
Age	.0233556 <i>.0282414</i>	-.0862361 <i>.0534887</i>
Age ²	.0002097 <i>.0002826</i>	.0017046*** <i>.0004914</i>
Health	-.1627251 <i>.1610898</i>	.6230308 <i>.5875407</i>
Exercise 4 times a week	-.1464125 <i>.1780388</i>	-.1630524 <i>.1907562</i>
Exercise 2-3 times a week	-.269551 <i>.191169</i>	-.3425385* <i>.206227</i>
Exercise once a week	-.3634322* <i>.2111045</i>	-.5463698** <i>.2315487</i>
Exercise once a month	-.6214255 <i>.4235107</i>	-.7929058* <i>.454965</i>
Exercise less than once a month	.0533496 <i>.3200706</i>	.0639627 <i>.3504038</i>
Body Mass Index (BMI)	.0563377*** <i>.0162642</i>	.0586886 <i>.0590929</i>
Married	.4407502** <i>.2224369</i>	.5059594** <i>.2397783</i>
Widowed	.3921869 <i>.3196268</i>	.3125906 <i>.3719472</i>
Divorced/Separated	.6208246* <i>.3464209</i>	.7706329** <i>.3692403</i>
Junior/Inter Cert	.4834224** <i>.1912741</i>	.5596273*** <i>.2078008</i>
Leaving Cert	.9677611*** <i>.2153527</i>	1.054467*** <i>.2355681</i>
Third Level	1.318593*** <i>.2640771</i>	1.144194*** <i>.286596</i>
Working	.13781 <i>.1533931</i>	.0968657 <i>.5680884</i>
Medical Friend	.0565459 <i>.1382837</i>	.0320427 <i>.1491778</i>
Frequent Drinker	.0775268 <i>.2205615</i>	-1.007193 <i>.817277</i>

Moderate Drinker	-.1387305 .1885519	-.1733469 .727537
Light Drinker	-.350868* .2020214	-1.183999 .8329689
Number of Children	-.0047368 .0330058	-.0721285 .1550796
Townsize	-.0693805*** .0157457	-.0915516* .0522048
Years Smoking	-.0242806*** .0048405	.0500239*** .0149428
No. of Cigarettes Smoked per Day	.0054459 .00703	-.0520226** .0263174
Age*Health		-.0154001 .0111441
Age*BMI		-.0001828 .001279
Age*Working		.0030836 .0135661
Age*No. of Children		.0010377 .0027607
Age*Frequent Drinker		.0260302 .0174398
Age*Moderate Drinker		-.0023596 .0145199
Age*Light Drinker		.0138997 .0151651
Age*Townsize		.0005374 .0010817
Age*Years Smoking		-.0019704*** .000343
Age*No. of Cigarettes Smoked per Day		.0014813*** .000555

***=significant at 99%, **=significant at 95%, *=significant at 90%

Table 4: Max Likelihood Estimates of Heckman Selection Model for Alcohol
(N=1108, 333 Censored)

Variable	No Age Interaction		Including Age Interaction	
	Selection	Level	Selection	Level
Age	-.0506684** <i>.0207938</i>	-.3992406* <i>.2180512</i>	-.0508697 <i>.0339944</i>	.0125261 <i>.2505215</i>
Age ²	.0001994 <i>.0001994</i>	.0031728 <i>.0022084</i>	.0002181 <i>.0002438</i>	-.0015916 <i>.0025284</i>
Health	.0814425 <i>.1166117</i>	-1.2111 <i>1.087611</i>	-.0718075 <i>.4272411</i>	-5.341465* <i>2.969153</i>
Exercise 4 times a week	.2610933* <i>.141226</i>	-.8366777 <i>1.480439</i>	.2820571** <i>.1407583</i>	-.8458839 <i>1.444637</i>
Exercise 2-3 times a week	.2612059* <i>.1423731</i>	.4532528 <i>1.528553</i>	.2824535** <i>.1425377</i>	.3201827 <i>1.507246</i>
Exercise once a week	.4020826** <i>.1545017</i>	-.7683158 <i>1.595832</i>	.4037311*** <i>.153768</i>	-.9931396 <i>1.559408</i>
Exercise once a month	.2854584 <i>.2901383</i>	2.612809 <i>2.87065</i>	.2738679 <i>.2914353</i>	2.278597 <i>2.876376</i>
Exercise less than once a month	-.1976282 <i>.3393006</i>	3.884504 <i>2.834155</i>	-.2028589 <i>.3467742</i>	3.65226 <i>2.816321</i>
Body Mass Index (BMI)	-.0314408** <i>.012586</i>		-.014417 <i>.0427805</i>	
Married	.2253738 <i>.1696331</i>	-3.041732** <i>1.427155</i>	.2796841* <i>.168154</i>	-2.789707** <i>1.406065</i>
Widowed	.0588892 <i>.2136304</i>	-2.04721 <i>2.164613</i>	.1011083 <i>.217378</i>	-1.726648 <i>2.146325</i>
Divorced/Separated	.4414157* <i>.2652933</i>	-3.416441* <i>1.992585</i>	.4894748* <i>.2628385</i>	-3.229571* <i>1.874651</i>
Junior/Inter Cert	.0359744 <i>.1331989</i>	1.273064 <i>1.296336</i>	.0151224 <i>.1327122</i>	1.507522 <i>1.278425</i>
Leaving Cert	.0243605 <i>.155597</i>	1.83035 <i>1.250151</i>	.0343547 <i>.1577482</i>	1.865736 <i>1.214019</i>
Third Level	-.0744403 <i>.1950348</i>	3.033438* <i>1.755865</i>	-.0431107 <i>.196378</i>	3.085173* <i>1.723322</i>
Working	.1833016 <i>.1248212</i>	1.005123 <i>1.067864</i>	-.728104 <i>.4775678</i>	3.74083 <i>3.678453</i>
Medical Friend	.2746299** <i>.1053409</i>	1.077455 <i>1.090492</i>	.2344202** <i>.1070982</i>	-1.104424 <i>1.04237</i>

Variable	Selection	Level	Selection	Level
No. of Cigarettes per Day	.0116733** <i>.0052504</i>	.167769*** .0497508	.0381675* <i>.0196855</i>	.3953082** <i>.1757171</i>
Number of Children	.0075231 <i>.0233879</i>		-.1444549 <i>.1043936</i>	-2.215754** <i>.9781883</i>
Townsize	.0664211*** <i>.0120119</i>	.310683*** .1199342	.0752807** <i>.0362129</i>	.2806893** <i>.1208161</i>
Age*Health			.0032914 <i>.0072278</i>	.0799168 <i>.0579457</i>
Age*BMI			-.0003286 <i>.0007958</i>	
Age*Working			.0218032** <i>.0103772</i>	-.0845905 <i>.0900017</i>
Age*No. of Children			.0025316 <i>.0016724</i>	.0408498** <i>.0167009</i>
Age*Cigarettes Smoked			-.0005191 <i>.0003548</i>	-.00507 <i>.0036534</i>
Age*Townsize			-.0001804 <i>.0006458</i>	
ρ	-.1384664*** <i>.0357384</i>		-.1571892*** <i>.0392567</i>	
σ	11.60135*** <i>1.027995</i>		11.54079*** <i>1.037066</i>	
λ	-1.606398** <i>.4777891</i>		-1.814088** <i>.5210337</i>	
Wald Test of Independent Equations	14.63, P-value =0.0001		15.51, P-value = 0.0001	
LR Test for Excluded variables	0.316, P-value=0.854		0.424, P-value=0.935	

***=significant at 99%, **=significant at 95%, *=significant at 90%

Table 5: Bivariate Probit for Joint Determination of Smoking and Drinking (N=1108)

Variable	Not Including Age Interaction		Including Age Interaction	
	Smoking	Drinking	Smoking	Drinking
Age	-.0048609 <i>.0183608</i>	-.0359517* <i>.0186279</i>	.0218767 <i>.0282865</i>	-.0405153 <i>.0281075</i>
Age ²	-.0002307 <i>.0001837</i>	.0000712 <i>.0001788</i>	-.0000514 <i>.00022</i>	.0001038 <i>.0002222</i>
Health	.2246089** <i>.1116767</i>	.0313455 <i>.1097888</i>	.1027072 <i>.37229</i>	-.1205273 <i>.4115995</i>
Exercise 4 times a week	.017156 <i>.1227986</i>	.1030818 <i>.1234368</i>	.0432102 <i>.1241591</i>	.1276603 <i>.1246784</i>
Exercise 2-3 times a week	-.0036443 <i>.1265137</i>	.2236933* <i>.1301892</i>	.0362832 <i>.1279793</i>	.2370212* <i>.1313073</i>
Exercise once a week	.2956846** <i>.1416914</i>	.2815273* <i>.1505834</i>	.3340897** <i>.1429651</i>	.2972598* <i>.1520193</i>
Exercise once a month	.4267572* <i>.2424552</i>	.2899932 <i>.2764401</i>	.4583318* <i>.2444443</i>	.2910081 <i>.2793959</i>
Exercise < once a month	-.1173342 <i>.2253064</i>	.0250038 <i>.22558</i>	-.1018521 <i>.2270258</i>	.0392133 <i>.2266682</i>
Body Mass Index (BMI)	-.0445222*** <i>.0112319</i>	-.0251492* <i>.0111165</i>	.026062 <i>.0350666</i>	-.0157896 <i>.0356942</i>
Married	-.1513123 <i>.1407933</i>	.2914228* <i>.1534349</i>	-.220735 <i>.1443549</i>	.3278409** <i>.1577886</i>
Widowed	-.1851495 <i>.2094903</i>	.0777799 <i>.1992762</i>	-.1610393 <i>.2109426</i>	.1223529 <i>.2025328</i>
Divorced/Separated	-.1552137 <i>.2271374</i>	.5421571** <i>.2589332</i>	-.2295343 <i>.2305606</i>	.5836477** <i>.2624486</i>
Junior/Inter Cert	-.1807882 <i>.1264457</i>	.0953903 <i>.126537</i>	-.1848583 <i>.1276567</i>	.0974721 <i>.1271169</i>
Leaving Cert	-.8783546*** <i>.1396625</i>	.1833084 <i>.1353175</i>	-.8724854** <i>.1408191</i>	.1811518 <i>.1364974</i>
Third Level	-.9192369*** <i>.1702093</i>	.1052856 <i>.1742359</i>	-.8974247** <i>.1709675</i>	.1010352 <i>.1756796</i>
Working	-.1657412 <i>.1022707</i>	.1838017 <i>.1124588</i>	-.1165519 <i>.3317778</i>	-.531062 <i>.3904733</i>
Medical Friend	.0552167 <i>.0943257</i>	.1679732* <i>.0973916</i>	.0631385 <i>.0960102</i>	.1435923 <i>.0984372</i>

Variable	Smoking	Drinking	Smoking	Drinking
Number of Children	.0301844 <i>.0231682</i>	.00686 <i>.0219714</i>	.2148574** <i>.0938284</i>	-.1024622 <i>.0958102</i>
Townsize	.04061*** <i>.0101606</i>	.0662423*** <i>.0109917</i>	.0729202** <i>.0286494</i>	.0891213** <i>.0350768</i>
Age*Health			.002789 <i>.0067091</i>	.0027835 <i>.0069132</i>
Age*BMI			-.0015629** <i>.0007345</i>	-.0001932 <i>.0006897</i>
Age*Working			-.0003118 <i>.0080409</i>	.0160845* <i>.0085976</i>
Age*No. of Children			-.0030708** <i>.0015564</i>	.001761 <i>.0015176</i>
Age*Townsize			-.0006374 <i>.0005827</i>	-.0004558 <i>.0006321</i>
Q	.2253018*** <i>.0616499</i>		.2258669*** <i>.0616745</i>	
LR Test $\rho=0$	12.7059	Pr > chi2 = 0.0004	12.7491	Pr > chi2 = 0.0004

***=significant at 99%, **=significant at 95%, *=significant at 90%

Table 6: Seemingly Unrelated Regression (Current Smokers, N=256)

Variable	Not Including Age Interaction		Including Age Interaction	
	Smoking	Drinking	Smoking	Drinking
Age	.2777817 <i>.2676863</i>	.0181063 <i>.4602318</i>	.4602414 <i>.417564</i>	.406534 <i>.5587961</i>
Age ²	-.0050557* <i>.0028318</i>	.0013343 <i>.0049066</i>	-.0010552 <i>.0035503</i>	-.004312 <i>.0062805</i>
Health		-3.500847 <i>2.768375</i>		-14.2503* <i>7.903302</i>
Exercise 4 times a week	-4.585246*** <i>1.523884</i>	-3.061404 <i>2.691107</i>	-4.290162*** <i>1.506343</i>	-3.168533 <i>2.661683</i>
Exercise 2-3 times a week	-3.744997** <i>1.672244</i>	-6.761199** <i>2.975699</i>	-3.82695** <i>1.650966</i>	-6.293527** <i>3.024897</i>
Exercise once a week	-2.339859 <i>1.70724</i>	-3.54367 <i>3.181658</i>	-1.753783 <i>2.206165</i>	-3.705717 <i>3.189892</i>
Exercise once a month	4.558259* <i>2.350066</i>	-3.374166 <i>4.320267</i>	5.292529* <i>2.833822</i>	-3.024137 <i>4.308055</i>
Exercise < once a month	-3.085205 <i>2.687656</i>	7.961434* <i>4.735186</i>	-2.841358 <i>2.690437</i>	7.916028* <i>4.67927</i>
Body Mass Index (BMI)			.6747816 <i>.4593383</i>	
Married	-2.049152 <i>2.047339</i>	-9.847467*** <i>3.641092</i>	-4.040433* <i>2.224541</i>	-9.082124** <i>4.289972</i>
Widowed	-8.47609** <i>3.995673</i>	-2.841845 <i>6.904431</i>	-5.377929 <i>3.840901</i>	-1.515909 <i>6.592568</i>
Divorced/Separated	.3908972 <i>3.324841</i>	-16.1681*** <i>6.049932</i>	-2.263704 <i>3.634594</i>	-15.506** <i>7.006419</i>
Junior/Inter Cert	-.8485634 <i>1.739113</i>	-2.789509 <i>3.276341</i>	-1.601454 <i>1.727976</i>	-2.4783 <i>3.356208</i>
Leaving Cert	-8.083039** <i>3.748673</i>	-12.06927* <i>7.344374</i>	-10.54476** <i>4.504834</i>	-10.87408 <i>7.586131</i>
Third Level	-10.73996*** <i>3.736531</i>	-8.278094 <i>7.406392</i>	-12.18177*** <i>4.521283</i>	-7.890481 <i>7.336023</i>
Working	-3.305195 <i>1.510178</i>	-7.924224** <i>2.789207</i>		-2.502376 <i>7.271214</i>
Medical Friend		-3.013158 <i>2.153555</i>		-2.261246 <i>2.128968</i>

Variable	Smoking	Drinking	Smoking	Drinking
Number of Children	1.103112*** <i>.3277525</i>		5.024912*** <i>1.569185</i>	-.2253759 <i>3.031523</i>
Townsize	.3275728 <i>.2080367</i>	-.4156746 <i>.4038305</i>	.2067937 <i>.4628141</i>	-.3023864 <i>.4541801</i>
Age*Health				.2402689 <i>.1654176</i>
Age*BMI			-.0164529 <i>.0135646</i>	
Age*Working			-.0847119** <i>.0397886</i>	-.1106731 <i>.2158265</i>
Age*No. of Children			-.0742333*** <i>.0289099</i>	.0030941 <i>.0566057</i>
Age*Townsize			.0017209 <i>.0091719</i>	
Smoking Hazard	12.06684** <i>4.794284</i>	12.77236 <i>9.459172</i>	14.70786** <i>7.047739</i>	11.02379 <i>9.502261</i>
Drinking Hazard	-6.942817 <i>8.886693</i>	-45.30945*** <i>17.26257</i>	-13.25093 <i>10.10948</i>	-36.58821* <i>19.99214</i>
q		0.2067		0.2009
B-P Test p=0		10.937, Pr = 0.0009		10.538, Pr = 0.0012

***=significant at 99%, **=significant at 95%, *=significant at 90%