DISCUSSION PAPER SERIES

IZA DP No. 2589

# Peer Effects, Unobserved Factors and Risk Behaviours: An Analysis of Alcohol Abuse and Truancy among Adolescents

Rosa Duarte
José-Julián Escario
José-Alberto Molina

January 2007

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

# Peer Effects, Unobserved Factors and Risk Behaviours: An Analysis of Alcohol Abuse and Truancy among Adolescents

**Rosa Duarte**
*University of Zaragoza*

**José-Julián Escario**
*University of Zaragoza*

**José-Alberto Molina**
*University of Zaragoza and IZA*

Discussion Paper No. 2589
January 2007

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 2589
January 2007

# ABSTRACT

## Peer Effects, Unobserved Factors and Risk Behaviours: An Analysis of Alcohol Abuse and Truancy among Adolescents*

The objective of this paper is to examine the factors which affect alcohol abuse and truancy among adolescents. We propose a new theoretical specification in which alcohol abuse and truancy appear as derived demands, given that they condition peer group and family acceptance, and we introduce unobserved individual effects that can influence both behaviours. Empirically, our paper develops an analysis where, after controlling for the existence of unobserved individual factors affecting both decisions, we test for peer influences. Our results first show evidence that alcohol abuse and truancy share unobserved factors affecting both decisions, and then confirm the existence of significant peer group influences on these two deviant behaviours.

JEL Classification: I10, I12, I20, I21

Keywords: peer, unobserved factors, risk behaviours, alcohol, truancy, bivariate probit

Corresponding author:

José Alberto Molina
Department of Economic Analysis
Faculty of Economics
University of Zaragoza
Gran Vía 2
50005 Zaragoza
Spain
E-mail: jamolina@unizar.es

* Authors acknowledge the comments received from the participants of the XXXI Spanish Economic Analysis Meeting (Oviedo, 2006), where a previous version of this paper was presented. This paper has been partially financed by Project OTRI-FUNDEAR 2006-198.

## 1. Introduction

Alcohol abuse and truancy are two widespread risk behaviours which affect the adolescent population. In a recent study, the World Health Organization (WHO, 2005) established that "around 600,000 Europeans died of alcohol-related causes in 2002, representing 6.3% of all premature deaths in the Region (WHO European Region); more than 63,000 of those deaths were of young people aged 15-29 years". These figures, among others, demonstrate the magnitude of the problem of alcohol abuse among the young of Europe, a region which, according to WHO (2005), has an alcohol consumption "twice as high as the world average".

With respect to truancy, in a recent study, the OECD (OECD Program for International Student Assessment 2000, PISA 2000) established that about one in five secondary school students in the OECD countries has been absent, skipped classes or arrived late at school during the two weeks prior to the study, although in several countries the rate is up to 30% or higher (Spain 34%, Denmark 32.9%, Poland 29.2%, Greece 28.8%).

As is well known, the consumption of alcohol and other drugs has serious consequences for health, with special relevance to adolescence, a stage during which individuals develop their habits of life and consumption. Hawkins et al. (1992) concluded that drug and alcohol abuse undermines motivation, interferes with cognitive processes, contributes to mood disorders and increases the risk of accidental injury or death. The abuse of these substances can also imply a significant loss of the individual's human capital, thereby reducing the possibility of higher personal earnings (Dee, 1999; Cook and Moore, 2000). Moreover, alcohol abuse in adolescents may predict antisocial behaviours and alcohol-related problems in adulthood (Scheier et al., 1997).

Additionally, empirical evidence has been found on the strong relationship between low participation at school and educational failure (OECD, 2003). Studies, such as Baker et

al. (2001), state that truancy is “one of the early warning signs that youth are headed for potential delinquent activity, social isolation and/or educational failure”. Others cite school absenteeism or truancy as a risk factor for substance abuse (Roebuck et al., 2004; Duarte and Escario, 2006; Lundborg, 2006), delinquency, criminal activity, teen pregnancy and dropping out of school (Bell et al., 1994; Baker et al., 2001).

Given the relevance of these risk behaviours, our objective is to go deeper into the factors which determine both alcohol abuse and truancy, paying special attention to the influence of the family and peer-group of the adolescent, as well as other underlying factors which can determine these deviant behaviours.

Our work advances along two lines. First, from a theoretical point of view, we extend the model of DeCicca et al. (2000), which introduces the peer factor in the demand for drugs, to the consideration of individual sources of negative affect. We consider that alcohol abuse and truancy can be obtained as derived demands depending on personal, family and peer group variables. Moreover, contrary to the usual approach in empirical works, both behaviours cannot be considered independently, given that they share underlying unobserved factors which exert an influence on them.

Secondly, and consistent with the theoretical framework, the econometric specification addresses two important issues. The existence of these unobserved factors leads us to specify an econometric model where the error terms in the two equations are correlated. If the hypothesis of endogeneity between these variables cannot be rejected, that is to say, if we confirm the existence of unobserved factors affecting alcohol abuse and truancy, we cannot consider one of these variables as an exogenous determinant of the other, since the omission of this correlation will result in biased estimations for the other parameters.

Our econometric model also captures peer group influences on alcohol abuse and truancy. We define classmate peer variables, rather than school-based variables, because they seem more appropriate measures of peer group effects. Nevertheless, the possible endogeneity outcome, derived from the distinction between "endogenous and contextual effects" (Manski, 1993), leads us to proceed in two ways: to instrument the peer group behaviour variables, and to consider some school fixed-effects variables, following the strategy of Gaviria and Raphael (2001).

As a consequence, our work is consistent with the past and present literature in the field, but addresses an important issue that has, as far as we know, not been studied in the research of peer effects and risk behaviours: to evaluate the peer effects after controlling for the presence of unobserved factors.

From the empirical point of view, the relevance of the above-mentioned problems to Spain is clear. Recent international data puts Spain among the countries in the European Union with the highest level of per capita alcohol consumption (World Health Organization, 2001). Moreover, the most recent data provided by the SDUSP show that more than 40% of adolescent students admitted to having been drunk during the previous month. Similarly, the results provided by the OECD (2003) put Spain at the head of the OECD countries in school absenteeism, with 34% of students skipping classes, a much higher figure than the OECD average of 20%.

On this basis, our work uses the 2004 Spanish Survey on Drug Use in the School Population (SDUSP), provided by the Spanish Government Delegation for the National Drugs Plan (Spanish Ministry of Interior), a representative survey of the school population in Spain. We focus on students aged between 14 and 15, a population for which secondary education in Spain is compulsory. The sample does not include those adolescents who decided to drop out of the educational system.

The rest of the paper is structured as follows. Section 2 presents the relevant existing literature. Section 3 is devoted to developing the theoretical model. Data and variables, as well as the econometric specification and strategy, are described in Section 4. In Section 5 we present the results, and Section 6 closes the paper with a summary of the main conclusions.

## 2. Relevant literature

Research into alcohol abuse and school absenteeism or truancy has a long history in the psychological, sociological and economic literature, and there is a high level of agreement on at least three relevant features.

First, truancy and other irregular behaviours go hand in hand with alcohol abuse in adolescence and youth, with a number of articles mentioning truancy as a predictor of the consumption of alcohol and other drugs (Laukkanen et al., 2001; Hallfors et al., 2002; Chou et al., 2006). Other studies maintain that alcohol and drugs are factors which interfere in the cognitive capacity of the students, and in their attitudes at school, with these being powerful indicators for low educational attainment, school absenteeism and dropping out of school (Yamada et al., 1996; Roebuk et al., 2004; Duarte et al., 2006).

Secondly, adolescents, when making their decisions, are strongly influenced by their close environment (family, peer-group, school, neighbourhood), with the impact of the family and the peer group being especially relevant to the decision to consume alcohol and other drugs, and to the decision to develop school deviant behaviours, such as skipping classes. In this line, several articles observe that family characteristics, including low economic status or living in a single-parent family, have consistent

covariates with antisocial behaviours at these ages (Lahey et al., 1999; Dekovic et al., 2004). However, as Dekovic et al. (2004) note, as children approach adolescence they spend increasing time with their peers, who become the most important reference group for them. As a consequence, the literature has found empirical evidence that adolescents who belong to peer groups with deviant behaviours are more likely to exhibit substance abuse (Aseltine, 1995), school problems (Berndt and Keefe, 1995) and other antisocial behaviours.

Thirdly, it is also recognized that it is not only the environment that determines the final decisions of adolescents. Personal characteristics, as well as other sources of negative affect (e.g., stressful life events or personal failures), are powerful risk factors for alcohol and drug abuse in adolescence (Bates and Labouvie, 1997; Colder and Chasin, 1999; Laukkanen et al., 2001) and for other deviant behaviours (He et al. 2004).

Moreover, this literature also establishes that the existence of peer influences will imply that a particular social policy directed to adolescents could have an amplified effect on society, through the indirect influence of peer groups, with this relationship being seen as a way of generating "social multipliers" (Manski, 1993). However, this paper also recognises the importance and difficulty of correctly addressing this peer influence, given the problems of bi-directionality of the influence between the individual and the group, and spurious influences derived from sorting across groups.

With respect to educational attainment, articles such as Winkler (1975), Borjas (1994), Aaronson (1998), Sacerdote (2001) and Hanusek et al. (2003), point out that belonging to a deviant peer group can lead the student to high rates of school absenteeism, low commitment to studies and low levels of educational achievement.

As for the consumption of alcohol, tobacco and other drugs, the main line of research has focused on their addictive character (Becker and Murphy, 1988, Chaloupka, 1991),

although this literature accepts that some of these consumptions depend on related actions in the person's reference group (Becker, 1996). The specific study of peer group influences on the consumption of these substances has been introduced into the economic literature more recently with works such as DeCicca et al. (2000) and Gaviria and Raphael (2001), opening the way for both the theoretical and empirical consideration of peer group influences on these behaviours.

In particular, DeCicca et al. (2000) present a theoretical model where the demand for drugs depends on peer acceptance, an influence which is introduced in the utility function, and that allows them to find differences between ethnicities in consumption. In turn, Gaviria and Raphael (2001) can be considered as one of the first works that develop an econometric strategy suitable for addressing the problems of endogeneity which arise in the definition of the peer group effect, as recognised in Manski (1993). Research in this empirical line has been continued recently with the contributions of Powell et al. (2005) and Lundborg (2006). In all of them, empirical evidence has been found supporting peer group influence on the consumption of drugs and other deviant behaviours.

However, as the psychosocial literature recognises, though the influences of the family and the adolescent's peer-group are relevant to the explanation of the individual's behaviours, we cannot overlook another group of personal factors that, although not directly observable in most cases, also condition the final decision of the adolescents with respect to their consumption, or to their attitudes towards school. Among these sources of negative affect, stressful life events or personal failures are included (Bates and Labouvie, 1997; Colder and Chasin, 1999; Laukkanen et al., 2001). These unobserved factors have been reflected theoretically by Becker and Murphy (1988) who consider that the beginning of harmful addictions, such as heavy drinking, is often

traceable to stressful events (anxiety, tension, insecurity, and others). These are difficult to measure, but are incorporated into the utility of the individual. Nevertheless, to date, no empirical works have been published that explicitly include these effects.

## 3. Theoretical framework

Our starting point, the same as for DeCicca et al. (2000), is to recognise that the individual in general, and the adolescent in particular, makes choices by comparing the perceived marginal benefits with the perceived marginal costs of each decision. Thus, he/she will decide to consume substances like alcohol, tobacco or other drugs if he/she perceives that the benefits obtained from this consumption (for example, in terms of recognition/leadership in the peer group, positive physical sensations, sense of freedom, disinhibition, and so on) overcome the perceived costs of these consumptions. A similar reasoning will drive his/her decision to go to classes or to skip classes.

In this context, we consider that the individual utility depends on the alcohol consumption ($A$), leisure time ($L$), time devoted to studying and to going to classes ($S$), and the consumption of other goods ($X$).

In our utility function we try to reflect four important aspects that, to the best of our knowledge, have not, so far, been considered simultaneously in the literature. First, as Pacula (1998) notes, the consumption of alcohol depends on a group of personal characteristics that influence the individual's marginal utility of consuming alcohol. In order to capture this fact, we introduce a function $b=f(W)$ that weights, for each individual, the utility obtained from this consumption according to the individual

characteristics *W*. This weighted sub-utility function is a component of the individual utility function[1].

Secondly, as DeCicca et al. (2000) note, individuals obtain utility from the peer acceptance (*PA*) produced by alcohol consumption, as well as truancy. We extend their approach by considering that this peer acceptance depends on the behavioural attitudes observed in the peer group (*Zp*). For example, if the individual belongs to a group with deviant behaviours, alcohol consumption or skipping classes will be valued more highly than if he/she belongs to a more responsible group. In this way, we introduce the influence of the reference group on both decisions, alcohol abuse and truancy, into the utility function, capturing the proposal of Becker et al. (1994).

Thirdly, we consider that the individuals receive utility from family acceptance (*FA*), which also depends on alcohol and truancy, although we can expect a different valuation of these risk attitudes in the family than in the peer group. The inclusion of this strategy is also an extension of the DeCicca et al. (2000) specification.

Finally, we introduce into the utility function a term *e* which reflects a group of individual unobserved factors affecting the individual utility and conditioning the consumptions and behaviours. By doing so, we incorporate the proposal of Becker and Murphy (1988) and other psychosocial works with respect to stressful events or personal failures, which condition utility and influence the consumption of substances such as alcohol, and other non-desirable behaviours, e.g., truancy. As a consequence, the individual maximizes:

$$U=U\,(b*V(A),\ PA(A,S,L,Z_p),\ FA\,(A,S,L),\ X,\ e)$$

[1] The original proposal of Pacula (1998) considers a utility function that is separable into drug consumption and other goods. In this work, we assume a more general utility function that does not necessarily imply this simplifying assumption.

subject to the standard budget and time restrictions, where good $X$ can be considered as numeraire:

$$P_A * A + X = I$$

$$L + S = H$$

with $P_A$ being the price of alcohol, $I$ the personal income and $H$ the total number of school hours programmed by educational authorities, which the adolescent distributes between school and leisure (truancy). Moreover, as has been noted, $b=f(W)$ is a function of personal characteristics which weight the utility perceived from the consumption of alcohol.

The first order conditions associated with this maximization problem are:

$$U_x - \lambda_I = 0$$

$$U_{bV} * b * V_A + U_{PA} * PA_A + U_{FA} * FA_A - \lambda_I * P_A = 0$$

$$U_{PA} * PA_S + U_{FA} * FA_S - \lambda_H = 0$$

$$U_{PA} * PA_L + U_{FA} * FA_L - \lambda_H = 0$$

where $\lambda_I$ and $\lambda_H$ are the Lagrange multipliers of the first and second restrictions, respectively.

In this context, the demands for alcohol consumption, leisure time(truancy) and school time can be obtained as derived demands:

$$X = X(P_A, I, W, Z_P, e)$$

$$A = A(P_A, I, W, Z_P, e)$$

$$S = S(P_A, I, W, Z_P, e)$$

$$L = L(P_A, I, W, Z_P, e)$$

Note that the derived demands for alcohol consumption and truancy provide a specification which depends on economic variables and personal characteristics, as well as on peer group behaviours and unobserved factors.

## 4. Empirical strategy

### 4.1. Data and variables.

In order to implement the above theoretical model, we have used the data provided by the Spanish Survey on Drug Use in the School Population for the year 2004, carried out by the Spanish Government's Delegation for the National Drug Plan. This survey constitutes a representative sample of the Spanish student population and includes broad information on drug use, personal characteristics, and family and school environments. All the information has been obtained directly from the adolescents, who answered the questionnaire anonymously. Parents were not present during the survey sessions, nor were they informed about their children's responses, in order to reduce underreporting. The information was collected in different state and private centres of secondary education and vocational training, with all the students aged between 14 and 16.

The dependent variables are *AlcoholAbuse* and *Truancy*, two dichotomous variables defined directly from the responses given to the questions: "During the last month, how many times have you been drunk?" and, "During the last month, how many times have you skipped classes?" The dependent variables take value 1 if the individual reports a positive quantity, and zero otherwise. As can be seen in Table 1, 37% of the students had been drunk during the previous month, and 38.2% had played truant in the same period.

With respect to the explanatory variables, two classmate peer variables have been defined to capture the influence of the peer group on the individual's behaviour,

*Alcoholpeer* and *Truancypeer*. These variables compute the percentage of alcohol abuse and truancy, respectively, in the classmate sample after eliminating the influence of the individual. That is, for an individual *i* belonging to class *c*:

$$Alcoholpeer_{ic} = \frac{\sum_{j=1 j\neq i}^{n} Alcoholabuse_{jc}}{n-1}$$

$$Truancypeer_{ic} = \frac{\sum_{j=1 j\neq i}^{n} Truancy_{jc}}{n-1}$$

In addition, other explanatory variables have been considered regarding the physical, social and economic characteristics of the adolescent (gender, age, available income, association) and family environment (level of studies of the parents, home without father). In order to address the peer effect correctly, avoiding the effect of sorting among schools, additional variables have been included for controlling school characteristics, such as state school (*versus* private school) and school with small classes (under 15 pupils). We have also considered it appropriate to include two variables referring to the presence of smokers at home, and the development of school campaigns about the risks of tobacco, alcohol and drug consumption. These variables can be seen, to a certain extent, as proxies both for the permissiveness of the family and the involvement of the school in the fight against drug use.

Finally, we have included 18 dummy variables corresponding to the Spanish autonomous regions, given that their omission could attribute some regional specific

effects to other exogenous variables.[2] Table 1 provides the definition and descriptive analysis of the above-mentioned endogenous and explanatory variables.

(Insert Table 1)

### 4.2. Empirical model and strategy

In order to analyse the alcohol abuse and the truancy behaviours simultaneously, we use a bivariate probit model. The consideration of the two dependent variables enables us to assume that there are unobserved effects that influence both behaviours. Thus, we can present two latent variables:

$$y_1^* = Alcohol\ Abuse^* = x_1'\beta_1 + e_1 \quad (1)$$

$$y_2^* = Truancy^* = x_2'\beta_2 + e_2 \quad (2)$$

where $e_1$ and $e_2$ follow a bivariate normal distribution with vector of mean zero and unitary variance**.** Therefore, $e_2 = \rho\, e_1 + \xi$, where $\rho$ is the correlation coefficient. This can be interpreted in the following way: the same unobserved variable $e_1$ exerts an effect on both latent variables, but not of the same magnitude.

However, we only observe $y_1$ and $y_2$ as dichotomous variables indicating if the adolescent has been drunk, and has skipped classes, respectively:

$$y_1 = \begin{cases} 1 & if \quad y_1^* = x_1'\beta_1 + e_1 > 0 \\ 0 & otherwise \end{cases} \quad (3)$$

$$y_2 = \begin{cases} 1 & if \quad y_{12}^* = x_2'\beta_2 + e_2 > 0 \\ 0 & otherwise \end{cases} \quad (4)$$

Thus, we can control for unobserved effects that exert an influence on both equations.

[2] For the sake of brevity, these estimates do not appear in the results tables, but are available upon request.

For the Maximum Likelihood estimation of this model we proceed as follows. We denote the joint distribution of ($e_1$, $e_2$) by $\Phi(0, 0; \rho)$. Therefore, the joint probability distribution can be expressed as:

$$P_{00} = Prob(y_{1i} = 0, y_{2i} = 0) = \Phi(-x_{1i}\beta_1, -x_{2i}\beta_2; \rho) \quad (5)$$

$$P_{10} = Prob(y_{1i} = 1, y_{2i} = 0) = \Phi(x_{1i}\beta_1, -x_{2i}\beta_2; -\rho) \quad (6)$$

$$P_{01} = Prob(y_{1i} = 0, y_{2i} = 1) = \Phi(-x_{1i}\beta_1, x_{2i}\beta_2; -\rho) \quad (7)$$

$$P_{11} = Prob(y_{1i} = 1, y_{2i} = 1) = \Phi(x_{1i}\beta_1, x_{2i}\beta_2; \rho) \quad (8)$$

As a result, we can write the likelihood as:

$$L(\beta_1, \beta_2; \rho) = P_{11}^{y_1 y_2} P_{10}^{y_1(1-y_2)} P_{01}^{(1-y_1)y_2} P_{00}^{(1-y_1)(1-y_2)} \quad (9)$$

Before implementing the estimation procedure, we follow the economic literature in order to account for the potential endogeneity of the variables that measure peer effects. We deal with this endogeneity by instrumenting the peer effect variables. Traditionally, researchers have used as instruments the class or school averages of some selected exogenous variables, after excluding the individual (Gaviria and Raphael, 2001; Lundborg, 2006). However, we consider that, even if these type of instruments could overcome the over-identification tests, from a conceptual point of view some doubts can still persist regarding their validity as instruments. Thus, in our view, it is inappropriate to assume that these class or school averages are uncorrelated with the disturbance terms corresponding to the equations of interest. Thus, we have used as instruments exogenous variables defined at provincial level, provided by the Spanish National Institute of Statistics. In particular, we have used as instruments for the peer-alcohol behaviour the following variables: unemployment rate, per capita income, death prevalence associated with lung cancer, cirrhosis, and car accidents (per 100,000 inhabitants), death prevalence for alcoholic psychosis (per 100,000 inhabitants) and

suicide rate (per 100,000 inhabitants). Similarly, in order to instrument the peer-truancy behaviour, the following variables are used: centres of child education per 1,000 children aged up to 14 years, the unemployment rate, the per capita income and traffic accidents (per 100,000 inhabitants).

In this way, and following Pacula (1998), and Evans and Ringel (1999), among others, we randomize peer group variables by exploiting differential rates of some socio-economic variables among the Spanish provinces.

With these instruments, we save the predicted peer effect variables and the residual vectors and, in order to assess the validity of the instruments, we carry out several tests, explained in the next section.

Given that we are using a two-step estimation procedure, we cannot use the standard errors reported in the maximum likelihood estimates, because they ignore the sampling variation in the coefficients estimated in the first step. In order to obtain valid standard errors we use the bootstrap procedure proposed by Efron (1979), which is a method of obtaining the distribution of an estimator by resampling from the original data set. We use 200 replications, since Efron and Tibshirani (1993) state that this is generally sufficient for standard error estimation.

## 5. Results

We carry out several tests in order to ensure the validity of the instruments. First, we check the joint significance of the instruments with an LR test. To that end, we regress the peer effect variables in terms of the exogenous variables, in addition to several instruments, that is to say, the five instruments for the peer alcohol effects and the four for the peer truancy effects. Then, we regress the same equations without the instruments, and compute the LR test statistics. Both reject the null hypothesis that the

coefficients of the instruments are zero, given that the LR statistics are, respectively, 41.70 and 124.77, which clearly exceed the 5% critical values of $\chi^2_{.95}(5) = 11.1$ and $\chi^2_{.95}(4) = 9.49$.

We have also carried out two over-identifying tests suggested by Bolen et al. (1995) and implemented in Lundborg (2006). In the first, we have compared, for each behaviour, the log-likelihood function of the following models: the probit model estimated by a two-stage procedure, and the probit model estimated after replacing the peer substance variable with the instruments. One test of the validity of the instruments can be obtained by comparing the log-likelihood values in both models. Under the null hypothesis of the validity of the instruments, both log-likelihood values should be similar. We evaluate this similarity with an LR test. In our case, the LR statistics take the following values, 0.90 for alcohol abuse, and 0.13 for truancy. Obviously, they do not exceed the 5% critical values of $\chi^2_{.95}(4) = 9.49$ and $\chi^2_{.95}(3) = 7.81$. Consequently, we cannot reject the validity of the instruments. The second test of over-identification consists of estimating the structural probit model, including all but one instrument. Under the null hypothesis of the validity of the instruments, they should not be significant after controlling for peer effects. The LR statistics of the joint significance of these instruments are 2.06 for alcohol and 5.43 for truancy, which are less than the critical values $\chi^2_{.95}(4) = 9.49$ and $\chi^2_{.95}(3) = 7.81$.

The maximum likelihood estimates for the bivariate probit model are presented in Table 2. The first column shows the estimated coefficients for the alcohol abuse equation, and the second column the estimates for the truancy equation.

(Insert Table 2)

We are primarily interested in the coefficients of the peer effects and in the existence of the unobserved life events that can affect both behaviours. The peer effect estimates appear at the top of the table. The results reveal, as we expected, that there is a positive and significant peer effect on both behaviours. That is to say, the higher the prevalence of these behaviours in the whole class, the higher the probability that the individual will take part in alcohol abuse and truancy. In addition, we find a positive and significant correlation coefficient, which is consistent with Becker and Murphy (1988). Thus, our estimates confirm the need to control for these unobserved effects.

Turning to the influence of the remaining variables on the alcohol abuse and truancy behaviours, we begin with the characteristics of the school. These variables help us to discriminate between spurious estimates or peer effects due to sorting, and true peer effects (Lundborg, 2006; Gaviria and Raphael, 2001). We find that, while the ownership of the school has no significant effect on both behaviours, the probability of truancy is lower for those students who go to classes with fewer than 15 students.

Concerning the physical characteristics, alcohol abuse increases with age among adolescents. Similarly, the probability of skipping classes is higher among the older students.

With respect to the family variables, those students who live without their father have a higher probability of getting drunk and skipping classes. However, we do not find any significant effect from the educational level of the parents. What does appear to have a significant effect, on both self-reporting alcohol abuse and truancy, is living with smokers. This can be interpreted as those parents who smoke are probably more permissive with other substances such as alcohol. Alcohol abuse by teenagers is also less probable among those students belonging to an association or club.

With respect to the economic status of the adolescent, which is measured by his/her available income, the estimates show that the probability of alcohol abuse and the probability of skipping classes are positively related to available income.

School information campaigns significantly reduce the probability of both behaviours, although in the alcohol abuse equation this variable appears significant only at the 10% level. This result has been found for marijuana smoking among Spanish adolescents by Duarte et al. (2006). Unfortunately, this effect is not sufficiently large to offset the increase in the probability of self-reporting alcohol abuse by the simple fact of becoming a year older.

As an additional analysis, and given that the interpretation of the $x_j$ coefficient, $\beta_j$, is that each one-unit increase in $x_j$ leads to increasing the probit index $x'\beta$ in $\beta_j$, for three relevant variables, *AlcoholPeer*, *TruancyPeer* and *Income*, we present the change in the probability yielded by a one-unit increase in $x_j$, that is to say, the marginal effect, which is easier to interpret and more meaningful. For this purpose, we compute $\frac{\partial \Phi(x_i\beta)}{\partial x_{ij}} = \phi(x_i\beta)\beta_j$ and average it over all individuals[3]. The results appear in Table 3, and can be interpreted in the following way. If students attend classes where the proportion of classmates that abuse alcohol is 10 points higher, then the probability of becoming a heavy drinker will increase around 9.9 points. Similarly, if adolescents attend class with a 10 point higher proportion of truants, their probability of becoming a truant will be 9.7 points higher.

(Insert Table 3)

[3] The density function has been evaluated using the true explanatory variables, that is to say, we have used the true peer effect variables instead of the instrumented peer effect variables. However, the results are very similar.

The changes in the probability of alcohol abuse and truancy of an increase of one unit in available income are also displayed in Table 3[4]. The estimates imply that an increase of 10 euros in the available income will increase the probability of heavy drinking by 3.1 points, and the probability of truancy by 2.7 points.

Finally, an interesting analysis is to compare whether peer effects are different across different groups of adolescents. Following Steimberg's (1987) suggestion that peer effects could be more important in families with fewer ties, we introduce an interaction term between the peer effect variables and the dummy variable indicating whether the father lives with the student or not. The results of this strategy appear in Table 4. As can be seen, the results do not confirm the hypothesis that students living in a household without the father are more sensitive to peer effects[5].

(Insert Table 4)

Additionally, in order to be more confident of our analysis, we enable the model to have different peer effects among state and private schools, given that the parents can choose the type of school in order to pre-select the classmates of their children. We

[4] In this case, the equation evaluated differs slightly from the one used before, as the variable income appears in levels and as its square. Now, we have averaged the following expression: $\frac{\partial \Phi(x_i\beta)}{\partial Income} = \phi(x_i\beta)(\beta_j^1 + 2\beta_j^2 * Income)$, where $\beta_j^1$ and $\beta_j^2$ are the coefficients associated with *Income* and *IncomeSquared*, respectively.

[5] It is natural to think that this interaction effect perhaps would be more significant if we had used a dummy variable indicating whether or not the mother lives at home. Unfortunately, due to a survey data error, this variable takes value one for all the individuals interviewed and, consequently, we cannot carry out this analysis. Nevertheless, other works, such as Lundborg (2006), use a dummy variable which includes the absence of one parent, mother or father, and does not find a significant interaction effect.

introduce an interaction between the peer effect variables and the dummy variable for state school. The estimates of this strategy appear in Table 5.

(Insert Table 5)

According to the results, while the peer effects continue to be significant, the corresponding interaction terms are significant in both equations. Therefore, there is no value in computing marginal effects for both types of school separately.

## 6. Summary and Conclusions

The objective of this paper was to go deeper into the study of the factors affecting two risk behaviours in adolescence, alcohol abuse and truancy, by considering both the influence of peer group behaviours on adolescent decisions, and the existence of unobserved individual factors which also condition these behaviours.

Overall, the findings presented in this paper are consistent with the theory of peer effect influences postulated by sociologists, but also confirm that these risk behaviours share a significant correlation, which leads us to study them non-independently.

The main results of our analysis have been presented in the paper. As a summary, we can highlight the following aspects.

First, the results confirm the existence of significant peer group influences on the consumption of alcohol and on the truant behaviour of adolescents. It can be observed that, apart from other personal and social factors, the fact that an individual belongs to a class with a 10% higher alcohol rate than another class, can raise his/her probability of being a heavy drinker by around 9.9 points, with similar results, 9.7, being obtained for truancy. Thus, these results confirm the existence of peer effects on the adolescent decision to develop risky attitudes such as alcohol abuse and truancy.

The existence of peer effects provides evidence of "social multipliers", that is, the effects of changes in the exogenous variables may be higher than those implied by the estimated coefficients. This is because an exogenous change will yield two effects. The first is a direct effect due to the impact of this variable on the probability of alcohol abuse or skipping classes. However, this is not the end of the story, since an indirect effect will appear due to the corresponding change in the proportion of classmates that abuse alcohol and play truant. In light of this, we can conclude that the change in the peer effect variable will reinforce the direct effect. This result is of great importance for policy makers, as peer effects may serve to amplify the effects of intervention policies.

Moreover, as has been said, our results provide evidence that alcohol abuse and truancy share unobserved factors that affect both decisions. Apart from the empirical consequences of this result, which will lead us to consider alcohol and truancy as not being exogenously determined, these unobserved characteristics seem to confirm the theoretical hypothesis of life events (Becker and Murphy, 1988) or sources of negative affect (Laukkanen et al, 2001) which determine risk behaviours, after controlling for other personal and social covariates. As a consequence, the development of policies which aim to reduce either of the two behaviours, alcohol abuse or truancy, could have a positive effect on the other behaviour, leading the individual to adopt healthier attitudes in both the school and group environments.

**References**


Aaronson D. Using sibling data to estimate the impact of neighborhoods on children's educational outcomes. *J Hum Resour* 1998; **33**: 915-946.

Aseltine RH. A reconsideration of parental and peer influences on adolescent deviance. *J Health Soc Behav* 1995; **36**: 103-121.

Baker ML, Sigman JN, Nugent M E. *Truancy reduction: Keeping students in school*. Washington, D.C.: U.S. Department of Justice, Office of Juvenile Justice and Delinquency Prevention, 2001.

Bates ME, Labouvie E W. Adolescent risk factors and the prediction of persistent alcohol and drug use into adulthood. *Alcohol Clin Exp Res* 1997; **21**: 944-950.

Becker GS, Murphy KM. A theory of rational addiction. *J Polit Econ* 1998; **96**: 675-700.

Becker GS, Grossman, M, Murphy, KM. An empirical analysis of cigarette addiction. *Am Econ Rev* 1994; **84**: 396-418.

Becker GS. *Accounting for tastes.* Harvard University Press. Cambridge, Massachusetts, 1996.

Bell AJ, Rosen LA, Dynlacht D. Truancy intervention. *The Journal of Research and Development in Education* 1994; **57**: 203-211.

Berndt T J, Keefe K. Friend's influence on adolescent's adjustment to school. *Child Dev* 1995; **66**: 1312-1329.

Bolen KA, Guilkey DK, Mroz TA. Binary outcomes and endogenous explanatory variables: tests and solutions with an application to the demand for contraceptive use in Tunisis. *Demography* 1995; **32**: 111-131.

Borjas G. Ethnicity, neighborhoods and human capital externalities. *Am Econ Rev* 1994; **85**: 365-390.

Chaloupka F. Rational Addictive Behavior and Cigarette Smoking. *J Polit Econ* 1991; **99**: 722-742.

Chou L, Ho Ch, Chen Ch, Chen WJ. Truancy and illicit drug use among adolescents surveyed via street outreach. *Addict Behav* 2006; **31**: 149-154.

Colder CR, Chassin L. The psychosocial characteristics of alcohol users versus problem users: data from a study of adolescents at risk. *Dev Psychopathol* 1999; **11**: 321-348

Cook PJ, Moore M J. *Environment and persistence in youthful drinking patterns.* NBER Working Paper Series. National Bureau of Economic Research. Cambridge, 2000.

DeCicca P, Kenkel D, Mathios A. Racial difference in the determinants of smoking onset. *J Risk Uncertain* 2000; **21**: 311-340.

Dee TS. State alcohol policies, teen drinking and traffic fatalities. *J Public Econ* 1999; **72**: 289-315.

Dekovic M, Wissink IB, Meijer, AM. The role of family and peer relations in adolescent antisocial behaviour: comparison of four ethnic groups. *J Adolesc* 2004; **27**: 497-514.

Duarte R, Escario JJ. 2006. Alcohol abuse and truancy among Spanish adolescents: a count-data approach. *Econ Educ Rev* 2006; **25**: 214-233.

Duarte R, Escario JJ, Molina JA. 2006. Marijuana consumption and school failure among Spanish students. *Econ Educ Rev* 2006; **25**: 472-481.

Efron B. Bootstrap methods: Another look at the Jackknife. *Ann Stat* 1979; **7**: 1-26.

Efron B, Tibshirani RJ. *An introduction to the bootstrap*. London. Chapman and Hall 1993.

Evans WN, Ringel JS. Can higher cigarette taxes improve birth outcomes? *J Public Econ* 1999;**18**: 135-154.

Gaviria A, Raphael S. School-based peer effects and juvenile behaviour. *Rev Econ Stat* 2001; **83**: 257-268.

Hallfors D, Vevea JL, Iritani B, Cho H, Khatapoush S, Saxe L. Truancy, grade point average and sexual activity: A meta-analysis of risk indicators for youth substance use. *J Sch Health* 2002; **72**: 205-211.

Hanushek EA, Kain JF, Markman JM, Rivkin SG. Do peer ability affect student achievement?. *J Appl Econom* 2003; **18**: 527-544.

Haussman JA. Specification tests in econometrics, Econometrica 1978; **46**: 1251-1271.

Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention. *Psychol Bull* 1992; **112**: 64-105.

He K, Kramer E, Houser RF, Chomitz, VR, Hacker K.A. 2004. Defining and understanding healthy lifestyles choices for adolescents. *J Adolesc Health* 2004; **35**: 26-33.

Lahey BB, Waldman ID, McBurnett K. 1999. The development of antisocial behavior: an integrative causal model. *J Child Psychol Psychiatry* 1999; **40**, 669-682.

Laukkanen ER, Shemeikka SL, Viinamäki HT, Pölkki PL, Lehtonen JO. Heavy drinking is associated with more severe psychosocial dysfunction among girls than boys in Finland. *J Adolesc Health* 2001; **28**: 270-277.

Lundborg P. Having the wrong friends? Peer effects in adolescent substance use. *J Health Econ* 2006; **25**: 214-233.

Manski C. F. Identification of endogenous social effects. The reflection problem. *Rev Econ Stud* 1993; **60:** 531-542.

OECD. *Student Engagement at School: A sense of belonging and participation. Results from PISA 2000*. OECD, 2003.

Pacula RL. Does increasing the beer tax reduce marijuana consumption?. *J Health Econ* 1998; **17**: 557-585.

Pacula RL. Adolescent Alcohol and Marijuana Consumption: Is there Really a Gateway Effect? *NBER working paper 6348*, 1998.

Powell LM, Tauras JA, Ross H. The importance of peer effects, cigarette prices and tobacco control policies for youth smoking behaviour. *J Health Econ* 2005; **24**: 950-968.

Register CA, Williams DR, Grimes PW. Adolescent drug use and educational attainment. *Education Economics* 2001; **9**: 1-18.

Roebuck M, Christopher F, Michael T, Dennis M L. Adolescent marijuana use and school attendance. *Econ Educ Rev* 2004; **23**: 133-141.

Sacerdote B. Peer effects with random assignment: results from Darmouth roommates. *Q J Econ* 2001; **116**: 681-704.

Scheier LM, Botvin GJ, Baker E. Risk and protective factors as predictors of adolescent alcohol involvement and transitions in alcohol use: A prospective analysis. *J Stud Alcohol* 1997; **58**: 652-667.

Steimberg L. Single parents, step parents, and the susceptibility of adolescents to antisocial peer pressure. *Child Dev* 1987; **58**: 269-275.

Winkler DR. Educational achievement and school peer group composition. *J Hum Resour* 1975; **10**: 189-204.

World Health Organization. *Drinking among young Europeans*. WHO Regional Office for Europe. Copenhague, 2001.

World Health Organization. *Alcohol policy in the WHO European Region: current status and the way forward*. Fact sheet EURO/10/05. Copenhague, 2005.

Yamada T, Kendix M, Yamada T. The impact of alcohol consumption and marijuana use on high school graduation. *Health Econ* 1996; **5**: 77-92.

Table 1. Descriptive analysis

| Variable | Definition | Mean (Std. Deviation) |
|---|---|---|
| AlcoholAbuse | This takes value 1 if the adolescent has been drunk in the last month and 0 otherwise | 0.370 (0.483) |
| Truancy | This takes value 1 if the adolescent has skipped classes in the last month and 0 otherwise | 0.382 (0.486) |
| AlcoholPeer | Alcohol abuse prevalence in the class after eliminating the individual's influence | 0.370 (0.203) |
| TruancyPeer | Truancy prevalence in the class after eliminating the individual's influence | 0.382 (0.159) |
| StateSchool | This takes value 1 if the school is a state/public school and 0 otherwise | 0.505 (0.500) |
| Class15 | This takes value 1 if the adolescent attends a class with fewer than 15 students and 0 otherwise | 0.209 (0.407) |
| Gender | This takes the value 1 if the young person is male and 0 if female | 0.488 (0.500) |
| Age14 | This takes value 1 if the adolescent is 14 years old and 0 otherwise | 0.350 (0.477) |
| Age15 | This takes value 1 if the adolescent is 15 years old and 0 otherwise | 0.650 (0.477) |
| WithoutFather | This takes value 1 if the adolescent lives without the father at home and 0 otherwise | 0.111 (0.314) |
| NoStudiesMother | This takes value 1 if the mother has no basic school certificate and 0 otherwise | 0.248 (0.432) |
| PrimaryStudiesMother | This takes value 1 if the mother has a basic school certificate and 0 otherwise | 0.248 (0.432) |
| SecondaryStudiesMother | This takes value 1 if the mother has a secondary school certificate or vocational training and 0 otherwise | 0.276 (0.447) |
| UniversityStudiesMother | This takes value 1 if the mother has a university diploma or a university degree and 0 otherwise | 0.228 (0.419) |
| NoStudiesFather | This takes value 1 if the father has no basic school certificate and 0 otherwise | 0.271 (0.444) |
| PrimaryStudiesFather | This takes value 1 if the father has a basic school certificate and 0 otherwise | 0.232 (0.422) |
| SecondaryStudiesFather | This takes value 1 if the father has a secondary school certificate or vocational training and 0 otherwise | 0.253 (0.435) |
| UniversityStudiesFather | This takes value 1 if the father has a university diploma or a university degree and 0 otherwise | 0.244 (0.430) |
| Membership | This takes the value 1 if the young person is a member of some association or club of a political, religious or sporting type and 0 otherwise | 0.538 (0.499) |
| FamilySmoking | This takes the value 1 if the adolescent lives with other individuals who smoke and 0 otherwise | 0.555 (0.497) |
| Income | Available income per week of the adolescent (in euros) | 12.846 (14.445) |
| InformationCampaigns | This takes the value 1 if the adolescent studies at a school which has information campaigns on the risks associated with tobacco, alcohol and drug consumption and 0 otherwise | 0.828 (0.378) |

Table 2:Estimation results

| Alcohol abuse | | | | Truancy behaviour | | | |
|---|---|---|---|---|---|---|---|
| Variable | Parameter | | Std. error | Variable | Parameter | | Std. error |
| PeerGroup | 3.133 | *** | 1.087 | PeerGroup | 2.779 | *** | 1.049 |
| StateSchool | -0.012 | | 0.051 | StateSchool | -0.048 | | 0.046 |
| Class15 | -0.120 | | 0.090 | Class15 | -0.127 | ** | 0.050 |
| Gender | 0.000 | | 0.038 | Gender | -0.050 | | 0.038 |
| Age15 | 0.186 | *** | 0.045 | Age15 | 0.137 | *** | 0.040 |
| WithoutFather | 0.259 | *** | 0.068 | WithoutFather | 0.297 | *** | 0.068 |
| PrimaryStudiesMother | -0.040 | | 0.079 | PrimaryStudiesMother | 0.083 | | 0.069 |
| SecondaryStudiesMother | -0.105 | | 0.075 | SecondaryStudiesMother | 0.054 | | 0.063 |
| UniversityStudiesMother | -0.089 | | 0.074 | UniversityStudiesMother | 0.040 | | 0.069 |
| PrimaryStudiesFather | 0.059 | | 0.078 | PrimaryStudiesFather | -0.007 | | 0.070 |
| SecondaryStudiesFather | 0.065 | | 0.074 | SecondaryStudiesFather | 0.011 | | 0.067 |
| UniversityStudiesFather | 0.053 | | 0.075 | UniversityStudiesFather | -0.032 | | 0.071 |
| Membership | -0.098 | *** | 0.036 | Membership | -0.073 | | 0.045 |
| FamilySmoking | 0.129 | *** | 0.038 | FamilySmoking | 0.138 | *** | 0.035 |
| Income | 0.012 | *** | 0.003 | Income | 0.009 | *** | 0.003 |
| IncomeSquared | 0.000 | * | 0.000 | IncomeSquared | 0.000 | | 0.000 |
| InformationCampaigns | -0.099 | * | 0.057 | InformationCampaigns | -0.124 | *** | 0.047 |
| Intercept | -1.675 | *** | 0.335 | Intercept | -1.336 | *** | 0.441 |
| Correlation coefficient | 0.133 | *** | 0.024 | | | | |
| Nº observ. | 5233 | | | | | | |
| Log. Likel. | -6722.14 | | | | | | |

Standard errors are obtained after bootstrapping with 200 replication
* significant at the 10% level. ** significant at the 5% level. *** significant at the 1% level.

Table 3: Average changes in the probability

| Alcohol abuse | | Truancy behaviour | |
|---|---|---|---|
| Variable | Probability change | Variable | Probability change |
| Alcohol Peer Group | 0.9918*** | Truancy Peer Group | 0.9699*** |
| | (0.2539) | | (0.1567) |
| Income | 0.0031*** | Income | 0.0027*** |
| | (0.0009) | | (0.0006) |

Standard errors in parentheses.
* significant at the 10% level. ** significant at the 5% level. *** significant at the 1% level.

Table 4: Estimation results (with interaction effects)

| Alcohol abuse | | | | Truancy behaviour | | | |
|---|---|---|---|---|---|---|---|
| Variable | Parameter | | Std. error | Variable | Parameter | | Std. error |
| PeerGroup | 3.244 | *** | 1.136 | PeerGroup | 2.830 | ** | 1.101 |
| PeerGroupWhithoutFather | -1.172 | | 0.834 | PeerGroupWhithoutFather | -0.477 | | 1.077 |
| StateSchool | -0.012 | | 0.055 | StateSchool | -0.047 | | 0.051 |
| Class15 | -0.118 | | 0.095 | Class15 | -0.127 | *** | 0.049 |
| Gender | 0.000 | | 0.041 | Gender | -0.050 | | 0.037 |
| Age15 | 0.186 | *** | 0.045 | Age15 | 0.136 | *** | 0.041 |
| WithoutFather | 0.680 | ** | 0.306 | WithoutFather | 0.478 | | 0.418 |
| PrimaryStudiesMother | -0.045 | | 0.080 | PrimaryStudiesMother | 0.083 | | 0.079 |
| SecondaryStudiesMother | -0.110 | | 0.074 | SecondaryStudiesMother | 0.056 | | 0.071 |
| UniversityStudiesMother | -0.091 | | 0.078 | UniversityStudiesMother | 0.041 | | 0.076 |
| PrimaryStudiesFather | 0.064 | | 0.076 | PrimaryStudiesFather | -0.008 | | 0.074 |
| SecondaryStudiesFather | 0.068 | | 0.067 | SecondaryStudiesFather | 0.010 | | 0.074 |
| UniversityStudiesFather | 0.055 | | 0.083 | UniversityStudiesFather | -0.032 | | 0.072 |
| Membership | -0.099 | ** | 0.041 | Membership | -0.073 | * | 0.041 |
| FamilySmoking | 0.129 | *** | 0.035 | FamilySmoking | 0.138 | *** | 0.034 |
| Income | 0.012 | *** | 0.003 | Income | 0.009 | *** | 0.003 |
| IncomeSquared | 0.000 | * | 0.000 | IncomeSquared | 0.000 | | 0.000 |
| InformationCampaigns | -0.100 | * | 0.056 | InformationCampaigns | -0.124 | ** | 0.054 |
| Intercept | -1.715 | *** | 0.344 | Intercept | -1.355 | *** | 0.467 |
| | | | | | | | |
| Correlation coefficient | 0.134 | *** | 0.023 | | | | |
| Nº observ. | 5233 | | | | | | |
| Log. Likel. | -6720.89 | | | | | | |

Standard errors are obtained after bootstrapping with 200 replication
* significant at the 10% level. ** significant at the 5% level. *** significant at the 1% level.

Table 5: Estimation results (with interaction effects)

| Alcohol abuse | | | | Truancy behaviour | | | |
|---|---|---|---|---|---|---|---|
| Variable | Parameter | | Std. dev | Variable | Parameter | | Std. dev |
| PeerGroup | 3.390 | *** | 1.033 | PeerGroup | 2.509 | ** | 1.124 |
| PeerGroupStateSchool | -0.600 | | 0.479 | PeerGroupStateSchool | 0.540 | | 0.664 |
| StateSchool | 0.214 | | 0.195 | StateSchool | -0.250 | | 0.255 |
| Class15 | -0.111 | | 0.085 | Class15 | -0.130 | ** | 0.055 |
| Gender | 0.000 | | 0.039 | Gender | -0.051 | | 0.039 |
| Age15 | 0.190 | *** | 0.047 | Age15 | 0.139 | *** | 0.039 |
| WithoutFather | 0.258 | *** | 0.067 | WithoutFather | 0.296 | *** | 0.062 |
| PrimaryStudiesMother | -0.044 | | 0.073 | PrimaryStudiesMother | 0.083 | | 0.074 |
| SecondaryStudiesMother | -0.105 | | 0.070 | SecondaryStudiesMother | 0.055 | | 0.070 |
| UniversityStudiesMother | -0.088 | | 0.079 | UniversityStudiesMother | 0.041 | | 0.071 |
| PrimaryStudiesFather | 0.061 | | 0.071 | PrimaryStudiesFather | -0.008 | | 0.077 |
| SecondaryStudiesFather | 0.066 | | 0.069 | SecondaryStudiesFather | 0.011 | | 0.076 |
| UniversityStudiesFather | 0.053 | | 0.072 | UniversityStudiesFather | -0.032 | | 0.070 |
| Membership | -0.099 | ** | 0.041 | Membership | -0.073 | * | 0.040 |
| FamilySmoking | 0.128 | *** | 0.039 | FamilySmoking | 0.138 | *** | 0.042 |
| Income | 0.012 | *** | 0.003 | Income | 0.009 | *** | 0.003 |
| IncomeSquared | 0.000 | ** | 0.000 | IncomeSquared | 0.000 | | 0.000 |
| InformationCampaigns | -0.101 | * | 0.058 | InformationCampaigns | -0.124 | ** | 0.054 |
| Intercept | -1.774 | *** | 0.332 | Intercept | -1.243 | *** | 0.452 |
| Correlation coefficient | 0.132 | *** | 0.022 | | | | |
| Nº observ. | 5233 | | | | | | |
| Log. Likel. | -6721.11 | | | | | | |

Standard deviations are computed from standard error derived after bootstrapping with 200 replication
* significant at the 10% level. ** significant at the 5% level. *** significant at the 1% level.