ILLICIT DRUG USE AND LABOR MARKET PARTICIPATION

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Summary

Empirical research on the relationship between illicit drug use and labor market success has been found to have mixed results in the literature. Relevant sources of variability are the methods used to account for the potential endogeneity of drug use. Using clinical data of drug users, this paper utilizes a recursive simultaneous-equations approach as an alternative for estimating the effect of consumption on labor participation and control the endogeneity problem. Our results confirm that drug use is endogenously determined, and provides evidence to support that frequent use of dependency drugs greatly decreases the likelihood of being active in the labor market. Our results underline the high labor market-related costs of drug use and abuse, mainly in terms of production loss.

Keywords: drug use, labor participation, endogeneity, simultaneous equation model.

JEL Classification: C31, I12, J23

Resumen

La investigación empírica de la relación entre consumo de drogas ilegales y participacion laboral presenta resultados no concluyentes en la literatura. Una de las fuentes de variabilidad más importante son los métodos utilizados para controlar la potencial endogeneidad del consumo. En el presente trabajo se utilizan registros clínicos de consumidores de drogas y un modelo recursivo de ecuaciones simultáneas como alternativa para estimar el efecto del consumo sobre la empleabilidad y controlar el problema de endogeneidad. Los resultados confirman que el consumo de drogas se determina de manera endógena y evidencian que un uso frecuente de drogas de dependencia reduce significativamente la probabilidad de participar en el mercado de trabajo. Estos resultados muestran los elevados costes laborales asociados al uso y abuso de drogas ilegales, principalmente en términos de pérdidas de productividad.

Palabras clave: consumo de drogas, participación laboral, endogeneidad, modelo de ecuaciones simultáneas.

Clasificación JEL: C31, I12, J23

1. Introduction

Illegal drugs use and abuse are directly related to health and social problems, which imply economic costs for both the individual and the society. Following the economic classification commonly used in cost-of-illness studies, illegal drugs consumption generates direct costs (direct healthcare; research, prevention and rehabilitation programs; legal costs, and so on), indirect costs related to labor productivity loss, and intangible costs, such as consumers' suffering.

On considering indirect costs, illegal drugs consumption causes health problems that indirectly affect the availability, quality and effectiveness of the labor force. Rice et al. (1990), for instance, is one of the first studies that assess the cost related to illegal drug consumption in the U.S. The authors calculate a total of 43.000 million dollars in 1985, 65% of which are indirect costs (productivity losses due to hospitalization and premature death). Harwood et al. (1998), accordingly, find that productivity losses account for the 71% of total costs generated by illegal drug consumption. Last estimations by the Office of National Drug Control Policy (2004) about the social cost of use of illegal drugs in the United States, offer a number of around 180 billion dollars, 71% of which are labor productivity losses.

Regarding the Spanish situation, García-Altés et al. (2002) and Oliva and Rivera (2004) are the reference studies. García-Altés et al (2002) adopt a social perspective for assessing the cost of illegal drugs in Spain during the year 1997. Indirect costs include in their work the loss of productivity related to death and hospitalization, which account for about 24,4% of total costs. Oliva and Rivera (2006) argue that the relative weight of indirect costs is much higher, and account for about 67% of total costs in their

estimation for the Autonomous Community of Galicia in 2003 (between 129 and 133 millions of Euros).

The significance and causal direction of the relationship between consumption and participation in the labor market is not clearly assessed in the existing literature. A number of studies suggest that illicit drug use negatively affect productivity and labor market position of individuals (French *et al*., 2001; Buchmueller and Zuvekas, 1998; MacDonald and Pudney, 2000; DeSimone, 2002; Alexandre and French, 2004; Van Ours, 2006). However, other researchers reported no significant effects or positive effects of illegal drug use on wages and labor market success (Gill and Michaels, 1992; Register and Williams, 1992; Kaestner, 1991, 1994). We should be cautious when comparing results across different studies. Observed variability may be attributed, among other factors, to the specification of labor market outcomes, the frequency measures, the sample of substance users considered in the analysis, the type of substances, and the methods used to address for the endogeneity of drug use. The potential endogeneity may come from a direct effect of income on drug consumption and from the (unobserved) approaches of individuals to labor market.

The objective of this paper is to analyze the relationship between dependency drugs consumption and labor market participation. To this end, we use a clinical record data (previous studies have used information from national surveys of individuals or households) for estimating a recursive bivariate probit framework as an alternative approach to control for the endogeneity of drug use. Results obtained here have interesting policy implications, which are related to the evaluation of different programs aimed at reducing the impact of illegal drug consumption on individual and social wellbeing. In fact, the regional Government of Galicia, Spain, dedicated 19 millions of Euros in assistance, prevention and social integration programs in 2008.

The paper is organized as follows. In section 2 we developed the econometric framework. The sample and the variables are described in section 3. The results of the empirical analysis are presented in section 4. Section 5 assesses the economic value of the loss generated by addiction, and the last section concludes.

2. Basic model and econometric specification

The model of Mullahy and Sindelar (1996), adapted by French et al. (2001), constitutes the theoretical basis of our estimations.

A relevant source of variability, in the results described in the introduction is the methods used in the existing literature to account for the potential endogeneity of drug use (DeSimone, 2002; Norton and Han, 2007). Illegal drug consumption and labor market participation are functions of different sets of variables,

$$F = f(p, w, X_F, \varepsilon_F) \quad [1]$$

$$L = l(p, w, X_L, \varepsilon_L), \quad [2]$$

where p is a price vector, w is a wage vector, and X_F and X_L are vectors of observed determinants of either consumption frequency (F) or the probability of participating in the labor market (L) –health and socio-demographic variables, variables related to consumption dynamics, previous treatments, and other risk factors-. ε_F and ε_L capture non observable factors related to either F of L.

Equations [1] and [2] can be obtained as a result of an optimization problem, where individuals maximize the utility of drug consumption and leisure, subject to the usual budget and time constraints. When it is assumed that preferences about consumption and leisure in the utility function are implicit and independent from prices, we obtain

$$F = f(L, X, \varepsilon) \quad [3]$$

$$L = l(F, X, \varepsilon), \quad [4]$$

where X includes all variables in both X_F and X_L, and ε all non observable factors in ε_F and ε_L. The main objective of the subsequent analysis is to obtain consistent estimates of the effect of F on L (equation 4), in which the potential correlation of *F* with ε is controlled for.

A relevant source of variability of results found in existing literature is the methodology used for solving the problem of endogeneity of consumption. Instrumental variables methods (*IV*), usually implemented in a two-step procedure, are quite common in the literature to correct for endogeneity (DeSimone, 2002; French *et al*., 2001; Norton *et al*., 1998; Register and Williams, 1992). However, these procedures require the existence of one or more valid instruments that do not directly explain the binary dependent variable, but are correlated with the endogenous variable. Weak correlation between the instrument and the endogenous variable implies a bias in *IV* estimates (Alexandre and French, 2004; Norton *et al*., 1998; Davidson and MacKinnon, 1993). Even with a plausible instrument, the dummy endogenous-variables model seems to raise some econometric problems when the endogenous variable and the outcome of interest are binary variables (Angrist, 1999; Foster, 1997; Terza *et al*., 2008). Summarizing, implementing a *IV* procedure in nonlinear regression models can lead to bias in the estimation of the effect of drug use on employment status.

Hence, we start by specifying a univariate probit model,

$$\Pr(L = 1) = \Pr(\beta x' + \varepsilon > 0) = \Pr(-\varepsilon < \beta x') = \Phi(\beta x'), \quad [5]$$

where *L* is labor participation, x' a vector of exogenous factors affecting labor status, included drug consumption, β is a vector of parameters, and Φ the cumulative

distribution function. Frequency of illegal drug consumption is also modeled by a univariate probit model.

On considering the analysis of the relationship between drugs consumption and labor participation, it has been argued that models specified as [5] are not consistent (MacDonald and Pudney, 2000). Since both drug use and being employed are dichotomous variables, simultaneous bivariate probit models (*BPMs*) appear to be appropiate alternative model specifications in order to control for potential endogeneity. We thus propose a specification of the *BPM,* a recursive model of simultaneous equations, provided that the second binary dependent variable appears on the right-hand side of the first equation (Maddala, 1983; Hardin, 1996; Greene, 1998, 2003). Interestingly, the endogenous nature of the variable can be ignored in formulating the likelihood function (Greene, 2003). Bivariate probit model is estimated using the *Full Information Maximum Likelihood* (FIML) method.

Participation in the labor force is modeled by the latent equation:

$$L^* = \beta_1 x' + \beta_2 F + \varepsilon_1, \qquad (6)$$

where the latent variable L^* is mapped to the observable binary indicator variable L:

$L=1$	if	$L^*>0$	in labor force.
$L=0$	if	$L^*\leq 0$	otherwise.

In eq. (6), x' is a vector of exogenous variables and F is a binary variable taking the value one when the individual is a frequent user of illegal drugs.

Drug use is assumed endogenous in eq. (6) and is determined by the following equation:

$$F^* = \delta_1 z' + \varepsilon_2, \qquad (7)$$

where F^* is the latent variable for frequent user, and z' is a vector of exogenous influences on frequency pattern. The unobserved latent variable F^* is related to the observable *variable by*

$F=1$	if	$F^*>0$	frequent illegal drug user.
$F=0$	if	$F^*\leq 0$	otherwise.

It is assumed that error terms ε_1 and ε_2 are jointly normally distributed with $E[\varepsilon_1|x', z'] = E[\varepsilon_2|x', z'] = 0$, $var[\varepsilon_1|x', z'] = E[\varepsilon_2|x', z'] = 1$ and $cov[\varepsilon_1, \varepsilon_1|x', z'] = \rho$.

The correlation coefficient ρ measures the correlation between omitted factors in both the employment and the frequency equations. When $\rho=0$, the model collapses to two separate probit models for L and F. On the other hand, when ε_1 and ε_2 are not independent, a recursive bivariate probit framework will yield consistent estimates (the separate estimates would be biased if $\rho\neq 0$). The Wald test is used to determine whether ρ is significantly different from zero (the null hypothesis is that $\rho=0$).

Finally, we are also interested in measuring the influence of frequent use on the probability of labor force participation. This effect can be estimated as a difference between the predicted conditional probabilities of participation in the labor market with and without a frequent drug use (Greene, 2003):

$$E(F) = Prob(L=1|F=1; x, z) - Prob(L=1|F=0; x, z). \quad [8]$$

3. Data and variables

We use unit record data obtained through a multicenter evaluation system that register, in a standardized manner, homogeneous data from the Drug Addiction Assistance Units (*DAUs*) of the Galician Regional Health Service, Spain. The main concerns when dealing with survey data are accuracy and validity, especially when the survey is designed to capture sensible information (MacDonald and Pudney, 2000). The use of

clinical registers presents some advantages respect to other sources, mainly related, in our situation, to the classification of consumers according to the frequency of use. However, a sample of individuals registered at healthcare units does not represent the whole population of illegal drug consumers, and we cannot thus generalize results and drawing valid policy implications for people whiteout access to any treatment.

DAUs are configured as the gateway to the public healthcare services related to drug abuse, and the origin of subsequent referrals to other specialized treatment services. Data capture is performed by *DAUs* health staff by face to face interviews at the time that the individual is admitted to treatment for abuse or dependence on a particular type of psychoactive substance. Admission in a *DAU* is performed on the basis of individual demand (48.32%), a demand from the individual's closest social environment (14.01%), derived from the GP (11.76%) or by judicial decision. In 2008, UADs assisted more than 11,000 individuals and gave them treatment related to illegal drug consumption (10,165 individuals), use and abuse of alcohol, nutritional disorders, compulsive gambling, or doping. During 2008, 2,984 new users were registered at one of the UADs for either abuse or dependency to illegal drugs. The main objective of this database is to obtain a set of indicators for planning actions related to drug use rehabilitation, prevention and social reintegration of illegal drug users.

The negative consequences of illegal drugs for worker productivity vary according to physical and psychological effects of each type of substance. We follow drug classification proposed by Ramsay and Spiller (1997) and MacDonald and Pudney (2000), and limit the study to individuals whose main consumption is illegal substances included in the group of so-called 'dependency drugs' (cocaine, heroin, and cocaine+heroin, coded as "primary substance consumed"). This group of drugs can seriously harm the health of the user and they have a greater presumed negative effect

on labor productivity compared to cannabis drugs use, which cause fewer health problems (DeSimone, 2002; Van Ours, 2006). In this analysis, specific models for cannabis users were not estimated because in the sample, consumption of cannabis shows to be secondary to the use of 'dependency drugs' (not mutually exclusive substances) and when we account for intensity of use, it is difficult to distinguish among the effects of this type of substance.

The impact of illegal drug consumption on employability may depend, among other factors, on both the intensity and the temporal dynamic of consumption. Following the classification of Buchmueller and Zuvekas (1998), and using as reference consumption during the whole month prior to treatment, we define two categories of consumption frequency: "Problematic consumers" are people with symptoms of pathologic consumption or dependency to the substance coded as principal drug (diary consumption). Diagnostic criteria of dependency and abuse are those applied by the health professionals that admit people to treatment. This classification is based on the addition diagnostic criteria of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* of the American Psychiatric Association.

The employment variable L is a binary indicator of those 'in labor force', which includes both employed people and self-employed, and those 'not in labour force', which includes the unemployed. We exclude from the definition individuals who were not in working age (in Spain the minimum age for working is 16 and the legal age for retirement was 65 at the time of the survey), full-time students, those who are permanently disabled, and prison population. The final sample includes a total of 1,754 consumers of dependency drugs, who were admitted to a treatment in 2008.

Table 1 presents the distribution of consumers of illicit dependency drugs according to frequency of consumption, as well as the percentage of working people in each

category. Without considering age groups, the proportion of unemployed is higher in all categories of frequency of consumption.

Table 1. Participation in the labor market by frequency of consumption.

	N=1,754			**Aged 16 to 34 (N=955)**			**Aged 35 to 65 (N=799)**	
Frequency of consumption	*% sample*	*% employed*		*% sample*	*% employed*		*% sample*	*% employed*
Pathological consumption	51.54	48.49		46.54	43.08		57.92	60.11
High-moderate consumption	21.24	25.98		27.44	33.41		13.32	16.81
Low consumption	27.21	23.31		26.02	23.50		28.75	23.08

Source: Own elaboration.

Though it could be expected to observe a higher rate of unemployment, at least in the category of pathologic consumers, the distribution reflects the reality of a sample of consumers that, by their own, decide to undertake a treatment to solve their problems. Data reported in table 1 suggest the direction of the causal relationship between consumption and employment; however, in order to assess the impact of consumption of illicit drugs on the probability of being employed, it is necessary to take into account other determinants.

Variables included in the analysis have been selected on the basis of a literature revision on the determinants of drug consumption and labor participation. Model identification is obtained by imposing exclusion constraints, by estimating alternative models, and by testing the significance of instruments included in the labor participation equation (Wald test). Variables included in the analysis and descriptive statistics are reported in Table 2. 46% of the sample can be classified as pathological consumer, whereas the percentage of people who are working is about 48% of the sample

Table 2. Variables and descriptive statistics.

Variables		mean	Standard deviation
Endogenous variables			
EMP	1=employed	0.484	0.499
FREQ	1=pathological consumer	0.515	0.499
Demographic and health variables			
AGE	age	33.695	7.581
AGEsq	Age squared		
ED1	1=without education	0.104	0.305
ED2	1= primary education	0.278	0.448
ED3	1=secondary education	0.592	0.491
ED4	1=university education	0.025	0.156
CRIMREC	1=without criminal records	0.40	0.49
MARRIED	1=married or living with a partner	0.141	0.348
URBAN	1= living in urban centre (>10.000 hab)	0.775	0.417
CHILD	1= if having children	0.384	0.486
HIVAIDS	1= VIH/AIDS positive	0.073	0.261
HEP	1= positive in hepatitis B or C test	0.366	0.482
Consumption, treatment and risk-related variables			
PSYTREAT	1=received previous psychiatric treatment	0.262	0.439
PREVTREAT	1= received some kind of treatment (not psychiatric)	0.672	0.469
SECDRUG	1= consumer of other dependency drugs	0.348	0.476
FIRSTUSE	1= initiated in illegal drug consumption before the age of 16.	0.201	0.401
ABST	1= More than one year without consuming	0.445	0.497
DRUGPART	1= if the individual has a drug-addicted partner	0.095	0.293
	N	**1,754**	

Source: Own elaboration.

On considering variables related to previous treatments and consumption patterns, it is worth noting the high proportion of people who have already received some treatment in the past (67%). About 26% of the sample followed an addiction-specific psychiatric treatment. Regarding consumption dynamic and its implications on actual intensity of consumption, 44.5% of patients declare to have passed through a period of abstinence during more than 12 months in their life.

4. Results

Table 3 shows results obtained of the probit model, where labor participation is the dependent variable, and where the frequency of consumption is taken as exogenous. The

same Table presents results of a probit model for the problematic consumption of dependency drugs. In order to assess the endogeneity of consumption, we estimated a probit model for labor market participation, in which we included as explicative variable the predicted values of the potentially-endogenous variable estimated in a previous step. The null hypothesis of exogeneity has been rejected by the Hausman test.

Table 3. Impact of pathological consumption on the probability of being employed; probit model specification.

	Employment equation		**Consumption equation**	
	Coef. (standard error)	Marginal effects	Coef. (standard error)	Marginal effects
FREQ	-0.007 [0.077]	-0.003		
URBAN	-0.03 [0.089]	-0.011	0.144*** [0.09]	+0.057
MARRIED	0.284** [0.125]	+0.112	-0.106 [0.125]	-0.041
CHILD	0.105 [0.089]	+0.041	0.073 [0.088]	+0.029
ED2	0.458* [0.155]	+0.181	-0.091 [0.145]	-0.036
ED3	0.598* [0.149]	+0.232	-0.193 [0.139]	-0.076
ED4	1.085* [0.277]	+0.382	-0.634** [0.267]	-0.231
AGE	0.026 [0.038]	+0.011	0.145* [0.04]	+0.057
AGEsq	-0.0002 [0.0005]	-0.0001	-0.01* [0.001]	-0.001
HIVADIS	-0.267*** [0.162]	-0.104	-0.223 [0.154]	-0.087
HEP	-0.265* [0.091]	-0.104	0.001 [0.092]	+0.001
CRIMREC	0.466* [0.081]	+0,184	0.147*** [0.082]	+0.058
DRUGPART			-0,064 [0.131]	-0.025
SECDRUG			0.239* [0.082]	+0.094
FIRSTUSE			0.106 [0.098]	+0.042
ABST			-0.039 [0.083]	-0.015
PSYTREAT			-0.125 [0.084]	-0.049
PREVTREAT			0.083 [0.097]	+0.032
_cons	-1.289** [0.649]		-3.057* [0.682]	
Wald chi2(12)=105.83*			Wald chi2(17)=62.60*	
Pseudo R2=0.0701			Pseudo R2=0.0403	
Levels: *1%, **5%, ***10%			Levels: *1%, **5%, ***10%	
N: 1,173			N: 1,165	

Source: Own elaboration.

The direct effect of problematic consumption of drugs on the probability of being employed is negative, though it is neither significant nor relevant. MacDonald and Pudney (2000), in their estimation with data from the British Crime Survey, obtain a similar result, that is, they find that dependency drug consumption positively affects the probability of being unemployed. French et al. (2001) reach the same conclusion and estimate that pathologic consumption determines a reduction of the probability of being employed of about 0.089.

Several works show that the level of education is a relevant variable that affect the relationship between labor market outcomes and drug consumption (Mullahy and Sindelar, 1989, 1993; French and Zarkin, 1995). Our results demonstrate that high educational levels have a positive and significant effect on the probability of working. Moreover, the lack of previous penal sanctions increases the probability of working of about 18%. On considering infectious diseases, both hepatitis and VIH/AIDS have a negative impact on labor market participation.

Table 4 presents the results of the bivariate probit model. Burguess and Propper (1998) point out that early initiation to unhealthy behaviors, such as illegal drug consumption, has long-lasting effects on labor productivity. On considering the consumption equation, for example, we observe that people who started to consuming drugs before the age of 16 have a greater probability of being a pathological consumer. Though they are not jointly significant, coefficient estimated for the education variables suggest that, with respect to the omitted category (no formal education), completing primary, secondary and university education reduces the probability of being a frequent consumer of dependency drugs.

Table 4. Impact of pathological consumption on the probability of being employed; simultaneous equation specification.

	Consumption equation (Robust Std. Err.)	Employment equation (Robust Std. Err.)	Total marginal effects
FREQ		-1.323*	-0.584
		[0.074]	
URBAN	0.108	-0.025	-0.05
	[0.88]	[0.081]	
MARRIED	-0.087	0.137	+0.109
	[0.127]	[0.116]	
CHILD	0.091	0.129	+0.042
	[0.089]	[0.083]	
ED2	-0.078	0.133	+0.101
	[0.143]	[0.134]	
ED3	-0.154	0.231***	+0.17
	[0.136]	[0.13]	
ED4	-0.487***	0.222	+0.34
	[0.259]	[0.244]	
AGE	0.061***	-0.011	-0.025
	[0.035]	[0.0104]	
AGEsq	-0.001	0.0004**	0.0004
	[0.0005]	[0.0002]	
HIVADIS	-0.211	-0.254***	-0.071
	[0.143]	[0.134]	
HEP	-0.019	-0.093	-0.044
	[0.091]	[0.082]	
CRIMREC	0.158***	0.381*	+0.161
	[0.082]	[0.076]	
DRUGPART	0.018		-0.005
	[0.099]		
SECDRUG	0.213*		-0.064
	[0.067]		
FIRSTUSE	0.155**		-0.046
	[0.074]		
ABST	-0.083		+0.026
	[0.066]		
PSYTREAT	0.044		-0.013
	[0.069]		
PREVTREAT	0.318*		-0.11
	[0.072]		
_cons	-1.786*		
	[0.595]		

rho= 0.906 [0.049]

Test de Wald: rho=0 (p value) chi2(1)=29.773 [0.0000]

Levels: *1%, **5%, ***10%. N: 1,162

Source: Own elaboration.

The analysis includes variables that capture the existence of previous treatments, which can be a factor that can alter personal behaviors. The probability of being a pathological consumer, however, is higher when the individual has received previous treatment aimed at reducing negative consequences of addiction. It is not easy to interpret this result: it would be necessary the degree of dependence when admitted to treatment, the subsequent dynamic of consumption and the specific kind of treatment received. The

coefficient for psychiatric treatment, on the other hand, is not significantly different from zero.

Existing literature suggest that being married or living with a partner is related to the reduction of drug consumption, and it is thus a protection factor against consumption of addictive substances (Bachman et al., 1997; Moos et al., 2002; Heinz et al., 2009). Variable MARRIED in our analysis has the expected sign but it is not statistically significant.

On considering the labor participation equation, our analysis underlines the existence of a significant impact of problematic drug consumption on the probability of being employed. The negative sign points to the lower participation of frequent consumers in the labor market: the reduction in the probability of working is equal to 0.584.

Our estimates are consistent with other studies in the literature. French et al. (2001), by using an instrumental variable approach, calculate that being a chronic consumer reduces of about 49.5% the probability of working. Alexandre and French (2004) by means of a specific survey, conclude that chronic consumption of injecting drugs has a negative effect on unemployment. Their conclusion follows from both their univariate probit model estimations and their estimations of simultaneous equation models. However, they find a much lower effect (a reduction of the probability of being employed between 8% and 10%).

The estimated correlation between errors (ρ) suggests that omitted factors that have an impact on problematic consumption, also affect labor participation. In fact, the hypothesis of exogeneity can be rejected. In other words, the recursive bivariate probit specification is an appropriate analytical framework for dealing with the effect of illegal drug consumption on labor market participation.

Several studies argue that a number of variables, such as education, family structure or health limitations, for example, may be endogenous in the drug consumption equation (Burgess and Propper, 1998; Kenkel and Ribar, 1994; MacDonald and Pudney, 2000; Register et al., 2001). We re-estimated the models discussed above without taking into account these variables. As a result, the direction of the relationship between consumption and labor participation remains unchanged. In the univariate probit model however, intensity of consumption of illegal drugs is significant in the new specification, and reduces the probability of working by 4.3% (see Table 5).[1] In the simultaneous equation model, the effect of this variable does not change with the new specification. The rest of estimated coefficients also maintain their sign, and only a few and minor changes can be appreciated in their impact on labor participation.

Table 5. Other specifications of the model to control for potential endogeneity.

Probi model[a]				**bivariate *probit* model**[a]			
	Coef.	*Std. Err.*	*ME*		*Coef.*	*Robust Std. Err.*	*Total ME*[b]
FREQ	-0.108***	0.065	-0.043	FREQ	-1.402*	0.521	-0.584
Wald chi2(5)	103.88*			*rho*	0.925	0.031	
Pseudo R2	0.0481			*Wald test of rho=0 chi2(1)*	53.59*		
N	1,592			*Observaciones*	1,588		

Source: Own elaboration.

Notes: [a] Respect to other models, the following variables have been excluded: MARRIED, CHILD, ED2, ED3, ED4, HIVADIS and HEP.

* significant at 1%, ** significant at 5%, *** significant at 10%.

Hence, our sample of people admitted to treatment permits to conclude that models that do not consider potential endogeneity are likely to produce biased results, and the

[1] Buchmueller and Zuvekas (1998), by using data from the Epidemologic Catchment Area (ECA) obtain a similar result with their probit model estimated for men aged between 30 and 45. A diagnosis of pathological consumption reduced the probability of being employed by 4%.

negative impact of consumption of illegal drugs on employment is underestimated in this situation.

5. Impact on labor productivity

This section attempts to assess the economic value of the loss of labor productivity related to the consumption of illegal drugs. The opportunity cost is assessed by the human capital framework, developed by Becker (1964), and commonly used in cost-of-illness studies. This methodology makes use of wages as a measure of the potential loss of production due to decreased time dedicated to work caused by illness. The main hypothesis of the human capital method is that the variability in wages is primarily due to differential accumulation of human capital by education and expertise (Puig and Pinto, 2001). Though this is the most used method in studies that estimate the social cost of consumption of illegal drugs and dependency substances, it is not exempt from criticisms, which are generally related to the existence of disequilibrium in the job market (involuntary unemployment), de choice of variable for shadow prices, and the different treatment of people according to their status in the job market. A relevant drawback is the overestimation of productivity losses, which follows from not considering the substitution of ill workers. In fact, it can be argued that the only relevant costs are those generated by the replacement of the ill worker and training of her substitute (Koopmanschap et al, 1995).

Friction costs method is one possible alternative, which consider unemployment and workers replacement. Within the friction costs method, productivity loss is not the relevant variable: the main focus is on the cost generated by the absence of a worker in a context of unemployment. In our dataset, information about transition across health

status, and frequency and duration of incapacity to work are not available and thus, the friction cost method cannot be applied.

By using the rate of unemployment in Galicia, the region being studied, we obtained the number of individuals potentially employed, when it is assumed that the consumers of illegal drugs have a level of employability similar to the general population. The monetary value of production has been approximated by the wage that an individual no longer obtain due to unemployment.

When it is assumed that both productivity and employability are similar to the rest of the population, the estimated loss of production related to consumption of illegal drugs is given by

$$PP = \sum [(PL_i' - PL_i])w_i \quad [9]$$

$$PL_i' = PT_i \cdot u_i\,, \quad [10]$$

where $\mathbf{PP}$ represents total lost production, $\mathbf{PL_i'}$ the number of potential consumers that should be working given the unemployment rate, $\mathbf{PL_i}$ the total number of consumers of illegal drugs that are actually working, w is the wage, $\mathbf{PT_i}$ the total number of consumers of illegal drugs, and $\mathbf{u}$ the unemployment rate.

Gross annual income is obtained from the *Encuesta de Estructura Salarial* (EES), which is a survey carried on by the Spanish institute of statistics (INE, 2008a), and includes individual incomes paid to workers per unit of time, and the remuneration for period of time during which the person did not work. Data on employment are obtained from the Active Population survey (INE, 2008b). Table 6 present the estimate of production loss related to consumption of illegal drugs by people admitted to treatment in 2008. Production loss is about 14 million Euros.

Table 6. Monetary value of production loss.

	Total	Unemployed	Excess unemployment	Loss (€) (average values - Galicia)	Loss (€) (average values - Spain)
				20 a 24 años	
Men	174	89	16	174,097	229,809
Women	32	22	6	31,484	68,771
				25 a 54 años	
Men	1,537	802	562	12,350,689	13,863,892
Women	221	150	75	1,397,945	1,457,834
			Total Production loss	**13,954,215**	**15,620,306**

Source: Own elaboration.

Note: Excess unemployment is equal to 0 in age intervals 16-19, and 55+.

5. Conclusions

The purpose of this paper has been to re-examine the relationship between illicit drug use and labor market status. To this end, we use clinical records of people admitted to treatment for either abuse or dependency to illegal drugs. We account for a possible unobserved correlation between drug use and labor participation by estimating a simultaneous equation, bivariate probit model, which is an alternative approach to the estimation techniques used in previous literature. We confirm that drug use is endogenously determined with labor participation and a *RBPM* is an appropriate method in order to control this problem. Though caution should be exercised when extrapolating results, our conclusions do not differ significantly from other empirical research and provides evidence, which support a highly significant relationship between drug use and participation in the labor force (after controlling for endogeneity). We have shown that frequent use of dependency drugs greatly decreases the likelihood of being in work.

Several limitations of the study must be considered. First, frequency of drug use is not the best predictor of whether or not an individual has a drug problem. Future research should consider individual physiological and psychological response to drug

consumption in the model specification (Buchmueller and Zuvekas, 1998). Second, it would have been interesting to analyze longitudinal data on the same individuals. Assuming that there is a lag before the effect of drug use is reflected in observed outcomes of labor market, the cross-sectional design does not allow us to analyze long-term consumption patterns and how these patterns were related to labor market performance.

From a policy-maker perspective, we have underlined the potential labor market-related costs of drug use and abuse, mainly in terms of production loss, and the need to integrate active employment policies and rehabilitation programs for users of psychoactive substances. From an empirical research perspective, our study has two contributions: the use of clinical data of drug users and a recursive simultaneous-equations model approach as an alternative for estimating the effect of drug use on labor participation.

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