

Teens' alcohol consumption and schooling

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Abstract

While research outside economics has found that drinking has a negative effect on cognitive skills, some economists have failed to find any negative relationship between drinking and academic performance. This paper argues that the reason for this discrepancy is due to the way education is measured in the economic literature. Herein, binge drinking in the senior year of high school is found to reduce the probability of receiving a high school diploma and to increase the probability of graduating with a General Education Development (GED). Moreover, this study finds that alcohol policies do not affect the dropout rate measured at the age of 25, but they do affect the probability that a student will graduate on time. In conclusion, bingeing is found to be responsible for inducing individuals to temporarily drop out of school. Eventually, these individuals return to school to complete their education, most likely by obtaining a GED diploma.

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1. Introduction

Alcohol consumption among teenagers has always been perceived as a social problem, mainly for the negative consequences of driving under the influence and other disruptive behaviors. Lately, there has been a growing concern that alcohol abuse may also interfere with the process of human capital acquisition. Clinical research has found that prolonged alcohol abuse has clear negative effects on both the health and cognitive skills of individuals (Brown, Tapert, Granhol, & Delis, 2000). Among other deficits, alcoholics have problems in proces-

sing information, learning new material, abstracting, and problem solving (Evert & Oscar-Berman, 1995). Given that cognitive skills are important determinants of school success, many economists have looked into how drinking affects the level of educational attainment. This study looks into the role that heavy alcohol consumption plays on the probability that a student will graduate from high school rather than receiving a General Education Development (GED) diploma. Also, the probability that students who consume alcohol will graduate on time will be analyzed. These are two important dimensions of the impact of drinking on educational attainment since GED graduates earn less than high school graduates (Cameron & Heckman, 1993) and individuals who graduate late earn less than individuals who graduate on time (Renna, 2006).

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The considerable frequency of alcohol consumption among adolescents in the US is surprising given that drinking is illegal for individuals under 21. A survey conducted in 2002 by the US Department of Health and Human Services concludes that nearly 30 percent of persons aged 12–20 consumed alcoholic beverages, with 20 percent reporting drinking five or more drinks in one instance (Substance Abuse and Mental Health Services Administration, 2003). Yet, the consequences of alcohol on educational attainment are not clear since some studies have failed to find evidence of a negative effect of drinking on educational attainment. This result may not be too surprising for the light form of drinking. However, these studies conclude that even heavy drinking does not affect educational attainment, which contradicts the initial intuitions about the relationship between drinking and human capital.

Educational attainment is typically defined in the current literature as number of years of completed education. According to this definition, receiving a high school diploma is equivalent to a GED diploma since they both are counted as 12 years of completed education. The GED program is very controversial. The diploma is awarded to individuals who pass a minimum standard on an exam administered by the American Council on Education. Initially created for Veterans, the American Council on Education began to offer the exam to high school dropouts in 1963. By 1987 more than 14 percent of the student population obtained a diploma by means of a GED exam rather than through a traditional high school curriculum. The purpose of the program is to certify that individuals with a GED diploma are equivalent to traditional high school graduates. However, the empirical evidence does not support this claim. In fact, an eminent paper (Cameron & Heckman, 1993) found that GED graduates are more similar to high school dropouts than to high school graduates in terms of both performance on psychometric tests and annual earnings. In light of these results, one wonders if looking at schooling in terms of years of education is the correct way to analyze the real effect of drinking on human capital accumulation.

This study looks at the effect of alcohol consumption on graduation rates, taking into account of the differences between high school graduates and GED recipients. Furthermore, it evaluates the impact that changes in alcohol policies may have had on the probability of receiving a high school

diploma rather than a GED. Alcohol policies have been found to reduce alcohol consumption among teenagers (Chaloupka, Grossman, & Saffer, 2002; Cook & Moore, 2002). If alcohol consumption has a negative effect on educational attainment, one would expect tougher alcohol policies to be associated with higher high school graduation rates. The hypothesis that alcohol increases the probability of receiving a GED implies that drinking affects when a student will complete his/her studies, since GED graduates tend to complete their 12th year of education late. Among the two youngest cohorts in the National Longitudinal Survey of Youth 79, only 8 percent of the respondents who had completed 12 years of education by the age of 19 received a GED. Six years later the percentage of individuals who received a GED increased to 13.6 percent. To shed light on the effects of teens' drinking on graduation age, this study will analyze the effect of alcohol policies on educational attainment measured at age 25 as well as at age 19.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature on the subject. Section 3 presents the model and Section 4 the data used for its estimation. The results from the estimation are discussed in Section 5. The paper concludes with some final remarks on the effects that underage alcohol consumption has on schooling.

2. Literature review

Early studies of the relationship between alcohol consumption and schooling found very large negative effects of drinking on educational attainment. Alcohol abuse was deemed responsible for decreasing the level of education between 1.5 years (Bentham & Bentham, 1982) and 2.3 years (Cook & Moore, 1993). Yamada, Kendix, and Yamada (1996) found that a 10 percent increase in the frequency of drinking decreases the probability of graduating from high school by 6.5 percent and Mullahy and Sindelar (1994) found that signs of alcoholism by age 22 reduce the level of educational attainment by 5 percent. However, except for Cook and Moore (1993), these studies neglected to control for the endogeneity of the drinking variable, casting serious doubts on the validity of the results. In fact, the direction of the causality between drinking and schooling can go both ways. If, on one hand, drinking might decrease the level of educational attainment, on the other hand poor school

performance might induce individuals to drink more. In fact, [Crum, Helzer, and Anthony \(1993\)](#) found that high school dropouts were 6.34 times more likely to develop alcohol abuse or dependence than individuals that continued in school.

The endogeneity of the drinking variable is a source of estimation biases if one fails to control for the effect of schooling on drinking. [Cook and Moore \(1993\)](#) first recognized this problem and used the state minimum legal drinking age (MLDA) and state alcohol taxes as instruments for the drinking variable. However, the authors overlooked the fact that the incidence of underage alcohol consumption varies dramatically across the 50 states ([Substance Abuse and Mental Health Services Administration, 2003](#)). This is not a minor detail since [Dee and Evans \(2003\)](#) showed that if one includes state dummies in Cook and Moore's regression analysis, the negative effect of drinking on schooling vanishes. Similarly, using a same-sex sibling pair strategy, [Koch and Ribar \(2001\)](#) found little or no effect of drinking on the level of educational attainment measured at the age of 25. More recently, [Chatterji and DeSimone \(2005\)](#) found that frequent drinking increases the probability of dropping out of school by 11–13 percent. This result is consistent with other studies that looked at the effect of illicit drugs on the high school dropout rate ([Roebuck, French, & Dennis, 2004](#)). However, since Chatterji and DeSimone measure educational attainment at the age of 19–20, one can only conclude that frequent drinking has a negative effect in the short run.

Some studies have suggested that alcohol may impact education more in terms of school performance than in terms of years of schooling. For high school students, [DeSimone and Wolaver \(2005\)](#) found that drinking reduces the probability that a student will receive an A, and increases the probability that he or she will receive a grade lower than B. This effect is stronger for binge drinking than for light drinking. Similarly, [Williams, Powell, and Wechsler \(2003\)](#) found that bingeing reduces a college student's GPA by half a letter grade. [Wolaver \(2002\)](#) found that, besides affecting students' GPAs, alcohol influences the choice of major, with a shift from majors that traditionally pay high salaries (like engineering) to majors that command lower salaries. In line with this body of research, this study tests the hypothesis that, even if there are no effects of drinking on the years of completed education, drinking will affect whether a student

graduates from high school or earns a GED diploma.

3. Model

The level of educational attainment (EDUC) can be specified as a function of the drinking habit (ALCOHOL) as well as a set of exogenous variables (X) commonly believed to affect EDUC:

$$EDUC_i = \alpha + \beta ALCOHOL_i + \gamma X + \varepsilon_i,$$

where ε is a random variable with a mean of 0 and variance of $\sigma(\varepsilon)$, and α , β , γ are the parameters of interest to be estimated. The variable EDUC can take three values: the individual may (1) drop out of school, (2) hold a GED, or (3) hold a high school diploma. This model will be estimated twice. In one specification the variable ALCOHOL will measure if the respondent consumed any alcoholic beverage over the 30 days before the interview (DRINK). Alternatively, ALCOHOL will measure the number of times the respondent has consumed more than five drinks in one single occasion in the month before the interview (BINGE). This measure of alcohol consumption is similar to the definition of "bingeing" adopted by the National Institute of Alcohol Abuse and Alcoholism.¹

Typically, some of the variables in X also affect the decision to drink. This implies that, if one neglects to include these variables, the estimation of β will be biased. Unfortunately some of those variables may be unobservable, thus making the estimation of the education equation challenging. For example, time preferences may affect both the decision to drink as well as the level of desired educational attainment, and if one cannot control for this factor, β will capture not only the effect of drinking but also the effect of time preferences on schooling. In fact, [DeSimone and Wolaver \(2005\)](#) show that the magnitude of β decreases when proxies for these unobservable variables are included in the regression. To control for this possible source of bias, a rich set of variables about individual expectations and self-esteem are added to the estimation. Those variables can be thought of as proxies for unobservable characteristics of the individual. Thus, it is hoped that this set of variables will catch some of the unobserved heterogeneity.

¹The National Institute of Alcohol Abuse and Alcoholism (2004) defines alcohol bingeing as "5 drinks or more for men" and "4 drinks or more for women".

Table 1
Descriptive statistics

Variable	Description	Mean	Std. dev.
<i>Dependent variables</i>			
EDUC	0 for dropout, 1 for GED, 2 for high school graduate	1.60854	0.666208
HS	1 for high school graduate	0.711235	0.453304
DROPOUT	1 for dropout	0.102694	0.303637
ON-TIME	1 for 12 years of education by the age of 19	0.715239	0.451417
<i>Alcohol variables</i>			
DRINK	1 if the respondent consumed any alcohol in the last month	0.551145	0.497504
BINGE	Number of times the respondent had more than 5 drinks in one day in the last month	0.883969	1.5126
<i>Covariates</i>			
MALE	1 for male	0.509405	0.500039
BLACK	1 for Black	0.257753	0.437508
HISP	1 for Hispanic	0.144891	0.35208
SIBS	Number of siblings	3.66192	2.56355
AFQT	Armed Forces Qualification Test	33.1688	26.5996
INTACT	1 for both parents still living at home	0.563803	0.496039
EDUC_M	Education of the mother	10.0361	4.05823
EDUC_F	Education of the father	9.25724	5.24001
MISSED_M	1 for mother education missing	0.0711744	0.257181
MISSED_F	1 for father education missing	0.1515	0.358626
INCOME	Log of family income	13.954	17.6811
YMISS	1 for missing family income	0.39756	0.489518
URBAN	1 for living in an urban area	0.771225	0.420151
F_ALC	1 for father having a drinking problem	0.181495	0.385525
EXPECT	1 if respondent expect to be in school 5 years from now	0.625318	0.484164
WORTH	1 if respondent feels to be worthy	0.973055	0.161963
QUALIT	1 if respondent feels to have good qualities	0.962888	0.189085
FAILURE	1 if respondent feels to be a failure	0.0437214	0.204527
CAPABLE	1 if respondent feels to be as capable as others	0.961362	0.192779
PROUD	1 if respondent feels nothing to be proud of	0.907473	0.289842
POSITIVE	1 if respondent has a positive attitude	0.901881	0.297551
SATISF	1 if respondent is satisfied with him/herself	0.916624	0.27652
RESPECT	1 if respondent wished he/she add more respect for him/herself	0.579563	0.493755
USELESS	1 if respondent felt useless at times	0.461108	0.498612
GOOD	1 if respondent felt he/she is no good	0.732079	0.442989
<i>Instrumental variables</i>			
MLDA19	1 for a MLDA of 19	0.368073	0.482404
MLDA18	1 for a MLDA of 18	0.236909	0.425294
TAX	Beer tax	0.536806	0.444694

For example, people with a positive attitude may be more future oriented and hence more inclined to accumulate human capital both as education and health. Following Cook and Moore (1993) and Dee and Evans (2003), the analysis controls for other covariates as well, namely demographics (gender and race), a measure of individual skills (AFQT score), family background variables (family income,² number of siblings, family intact, and

parents' education, an indicator for father having a drinking problem), and geographical variables (state of residence and the size of the city of residence). The descriptive statistics of the variables included in this study are reported in Table 1.

Even with such a rich data set, the unbiased estimation of the educational attainment equation may be hampered by additional problems. First, the

²The information on family income and parents' education is missing for a number of observations. To avoid eliminating too many observations from the analysis, this study uses the common

(footnote continued)

technique of keeping all observations and including a dummy variable that takes the value 1 if the information about income is not reported for a specific observation.

proxies used to control for the unobservable idiosyncratic characteristics may not capture all the factors that may simultaneously affect the decision to drink and the level of educational attainment. Second, the drinking habit, especially in the case of bingeing, may be reported with error. Finally, as suggested by [Crum et al. \(1993\)](#), the level of educational attainment itself may affect the drinking habit. In all of these cases, an instrumental variable (IV) strategy would be a preferred estimation. However, the procedure can be used only if one can identify some variables that affect the drinking behavior but not the level of educational attainment. The two variables commonly used for this purpose are the state MLDA and the state alcohol taxes. While the MLDA is currently set at 21 everywhere in the US, in the 1970s it varied across states. At the beginning of the 1980s, states started to move toward an MLDA of 21, especially after the federal government threatened to withhold federal highway funds from states that did not raise the MLDA to 21. This policy change created a natural experiment that is used to isolate the effect of this policy from unobservable state characteristics. From 1982 to 1983, 10 states raised their MLDA, seven of which had had an MLDA of 18 and two of which had had an MLDA of 19.

State alcohol taxes are another possible instrument that can be used to identify the drinking behavior separate from educational attainment. Since teenagers consume primarily beer, the tax per packaged case of 24 bottles or cans of 12 ounces of beer is used in this study. Beer taxes vary dramatically across the 50 states, from a low of 7.5 cents to a high of \$2.30 in 1982 US dollars. Unfortunately, only six states changed the tax rate over the 2 years under analysis, which implies that, once one controls for state fixed effect, most of the variation in this variable is only due to the effect of inflation. [Dee and Evans \(2003\)](#) demonstrate that this variation is insufficient to isolate the effect of the tax rate from the state fixed effects.

4. Data

A widely used data set for the analysis of a variety of youth related issues is the National Longitudinal Survey of Youth 1979 (NLSY79). At the time of the first interview in 1979, 12,686 individuals between the ages of 14 and 21 responded to the survey questions. The survey was terminated in 2002. During the 1982–84 surveys, a series of specific

questions aimed to elicit responses regarding drinking habits was added to the regular questionnaire. Since this study looks at the effects of drinking on high school graduation rates, only the two youngest cohorts of the survey, who were 18 in 1982 and 1983, are included in the analysis. This yields a total of 2263 observations.

The self-reporting nature of the data collected in the NLSY79 raises the issue of the reliability of the information on drinking. In order to encourage respondents to be truthful about these sensitive matters, the questions about drinking were not administered in the presence of an interviewer; instead, the respondents had to fill out a written questionnaire and mail a sealed envelope directly to the survey organization. The privacy of the respondents was guaranteed because the identity of the respondents could not be retrieved. While the NLSY79 is not the only survey containing information about teen alcohol consumption, it has a comparative advantage in that it was administered to everybody in the sample, and not only to individuals in school (as was the case for *Monitoring the Future*, for example). This allows early dropouts to be included in the sample.

During the administration of the alcohol survey, the NLSY79 respondents had to report if they consumed any alcoholic beverage during the 30 days before the interview. Individuals who answered affirmatively to this question were then asked how many times they engaged in alcohol bingeing, which is defined as consuming more than five drinks on one single occasion. More than half of the respondents in the sample reported drinking during the month preceding the interview and one-third reported bingeing. On average, bingers reported 2.5 days of alcohol bingeing. The majority had between one and three occurrences of alcohol abuse. Still 154 individuals reported four to six cases of bingeing.

In this study, the level of educational attainment is measured at two points in time in the life of the individual: first at age 19 and then at age 25. Because age 25 is the cut off used by the Census Bureau to define the drop out rate in the country, this measure is used for the analysis of the long-run effect of drinking on schooling, while the level of educational attainment at age 19 is used for the analysis of the short-run effects. By the age of 25, 72 percent of the individuals in the sample had a high school diploma and 11 percent had a GED diploma. Only 59 percent of the people in the sample had completed 12 years of education by the age of 19:

the majority of those had a high school diploma and only 90 students had a GED diploma.

5. Results

Table 2 reports the results of ordered probit estimations of the effects of drinking and bingeing on the level of educational attainment measured at age 25. The dependent variable takes the value 0 if the respondent is a dropout, 1 if he/she has a GED, and 2 if he/she has a high school diploma. These estimations ignore at the moment the potential endogeneity of the drinking variables.

Except for the race dummies, the results are consistent with the usual expectations: male and urban residents achieve lower levels of schooling. Higher scores in AFQT and parents' education

increase the probability of higher levels of schooling. If both parents are present in the household and the family income is higher, the probability of higher levels of educational attainment increases. Due to the correlation between the self-esteem variables, only some of the variables added to capture the idiosyncratic factors are significant. Feeling to be a failure and having low self-respect lower the probability of achieving a higher level of schooling. On the other hand, having a positive attitude increases the probability of achieving a higher level of schooling, but only in the estimation with the variable DRINK. Also, individuals who expect to be in school in 5 years have higher levels of schooling. Finally, Blacks and Hispanics have a higher rate of graduation. While surprising at first, this latter result is consistent with other empirical

Table 2
Ordered probit estimations of EDUC

	(1)		(2)		(3)	
	Coeff.	<i>t</i> -stat	Coeff.	<i>t</i> -stat	Coeff.	<i>t</i> -ratio
ONE	−0.7635**	−2.1161	−0.7648**	−2.0463	−0.5476	−1.2081
DRINK	—		−0.3157***	−4.3013	−0.1336	−1.3652
BINGE	−0.0928***	−4.0534	—		—	
MALE	−0.1628**	−2.2803	−0.1849***	−2.6449	−0.1360	−1.5523
SIBS	−0.0169	−1.2400	−0.0192	−1.4002	−0.0157	−0.9515
URBAN	−0.2941***	−2.9047	−0.2928***	−2.8987	−0.3679***	−2.9166
BLACK	0.7221***	7.3573	0.7283***	7.4297	0.8117***	6.7718
HISP	0.3740***	3.1518	0.3753***	3.1591	0.4467***	3.0323
AFQT	0.0286***	13.4194	0.0294***	13.7030	0.0273***	9.9806
MISSED_M	0.2339	1.2027	0.2613	1.3391	0.0767	0.3118
EDUC_M	0.0261*	1.7189	0.0281*	1.8413	0.0062	0.3277
MISSED_F	0.1068	0.7063	0.1201	0.7939	0.2057	1.0999
EDUC_F	0.0268*	2.1088	0.0288**	2.2530	0.0358**	2.2501
YMISS	−0.1393	−1.5060	−0.1316	−1.4187	−0.1539	−1.3220
INCOME	0.0080**	2.4944	0.0085***	2.6349	0.0085*	1.9756
F_ALC	−0.0586	−0.6784	−0.0462	−0.5328	−0.0014	−0.0118
INTACT	0.3320***	4.5957	0.3194***	4.4093	0.3888***	4.1209
EXPECT	0.4262***	6.0615	0.4158***	5.9035	0.3944***	4.3805
WORTH	0.2704	1.4285	0.2473	1.3075	0.1677	0.7595
QUALIT	−0.1811	−1.0499	−0.1818	−1.0532	−0.1884	−0.8555
FAILURE	−0.2902*	−1.8943	−0.2662*	−1.7338	−0.3248*	−1.6997
CAPABLE	0.1402	0.8495	0.1451	0.8783	0.2367	1.1839
PROUD	0.1063	0.9521	0.1099	0.9850	0.0444	0.3155
POSITIVE	0.1674	1.4765	0.1940*	1.7060	0.2773**	1.9766
SATISF	0.0466	0.3921	0.0374	0.3146	0.0731	0.4828
RESPECT	−0.1492**	−2.0513	−0.1458**	−2.0033	−0.1757*	−1.9177
USELESS	−0.0584	−0.7580	−0.0642	−0.8327	−0.0283	−0.2964
GOOD	−0.0716	−0.8249	−0.0821	−0.9440	−0.0445	−0.4028
No. obs.	1964		1964		1291	

State dummy variables included but not reported.

* (**, ***) denotes significance at the 0.10 (0.05, 0.01) level.

estimations based on the NLSY79 data set (Cook & Moore, 1993).³

The results in Table 2, column 1, suggest a negative correlation between educational attainment and bingeing. The marginal effects of the variable BINGE evaluated at the variable means show that one additional episode of bingeing per month is associated with an increase in the dropout rate by 1.43 percentage points, an increase in the probability of receiving a GED by 1.02 percentage points, and a decrease the probability of graduating from high school by 2.45 percentage points. The variable DRINK has a negative and significant coefficient as well (Table 2, column 2), suggesting that any form of alcohol consumption, light or heavy, has a negative effect on educational attainment. A more careful look into the correlation between drinking and educational attainment reveals that only heavy drinking is associated with deterioration in the level of educational attainment. If light drinking had a negative effect on schooling, one would expect the coefficient on the variable DRINK to also be negative and significant when comparing abstainers with light drinkers only. It appears, however, that the negative correlation between drinking and educational attainments is driven only by the heavy drinkers, for the variable DRINK becomes insignificant when the ordered probit estimation is run without individuals who report binge drinking (Table 2, column 3).⁴ This result indicates that only heavy drinking may have a negative effect on educational attainment and is consistent with some clinical literature that does not find a mental harm associated with light drinking (Delin & Lee, 1992). For this reason the rest of the paper will focus only on the excessive form of alcohol consumption.

The negative correlation between educational attainment and alcohol abuse of Table 2 cannot be read as causality unless BINGE is exogenous. This paper uses the procedure described in Bollen, Guilkey, and Mroz (1995) to test this hypothesis: the error term computed from a separate regression of the BINGE variable on the entire set of exogenous variables is added to the schooling equation estimation. The *t*-statistics on this error term provides a

simple test of the exogeneity of the alcohol variable: under the null hypothesis that the alcohol variable is exogenous, the coefficient on the error term should not be different from zero. The bingeing equation is estimated both as a Poisson and a Zero Inflated Negative Binomial to account for overdispersion and an excess of zeros, but for both estimation procedures adopted, one cannot reject the hypothesis that the variable BINGE is endogenous at conventional confidence levels.

Because BINGE is endogenous, one cannot tell from Table 2 if alcohol abuse causes lower levels of educational attainment or if the two variables are just correlated, i.e. individuals who tend to drink more also have lower level of educational attainment. Previous research has shown that alcohol policies affect alcohol consumption among teenagers (Coate & Grossman, 1988). Since alcohol policies are exogenous with respect to the educational attainment variable, one can use these variables as proxies for binge drinking. While this approach cannot retrieve the direct effect of bingeing on schooling, it is appealing for several reasons. First, if the coefficient of the alcohol policy variables is negative and significant, it will provide indirect evidence that bingeing has a negative effect on educational attainment (Chaloupka et al., 2002). Second, since alcohol policies are usually a common instrument that can be enacted to curb drinking, one can assess the impact on educational attainment of raising the MLDA or increasing a tax on alcohol. Last, since other studies have used this approach, one can compare the results of this study with the available literature.

Table 3 reports the results of two reduced form estimations that control for the same set of variables included in Table 2 except that MLDA18, MLDA19, and TAX replace BINGE.

The results of the ordered probit estimation confirm what was found by Dee and Evans (2003): since the alcohol policies are insignificant in the schooling equation, one can conclude that bingeing has no effect on educational attainment. However, the multinomial logit analysis reveals some interesting insights about how alcohol affects educational attainment.⁵ The probability of being a dropout and the probability of being a high school graduate are estimated with respect to receiving a

³This unexpected result could derive from the sampling strategy of the NLSY, which contained an over sample of poor whites.

⁴This conclusion is confirmed by a regression that includes the BINGE variable and a new variable denoting light drinking (but no bingeing).

⁵An alternative to the multinomial probit is the nested logit. However the number of parameters to estimate exceeds the maximum that the software LIMDEP can handle.

Table 3
Estimation results

	(1)	(2)		(3)	(4)		(5)
	Ordered probit	Multinomial logit		Probit	2-stage probit		Probit
	EDUC	DROPOUT	HS	ON-TIME	BINGE	HS	HS
MLDA18	−0.2867 (−0.831)	−1.1948 (−1.155)	−1.5458* (−1.800)	−0.4708** (−2.080)	0.3215** (2.212)	—	—
MLDA19	−0.3664 (−1.121)	−0.4155 (−0.433)	−1.0205 (−1.307)	—	—	—	—
TAX	−0.2409 (−0.700)	1.3788 (1.085)	0.8074 (0.675)	—	—	—	—
BINGE	—	—	—	—	—	−1.0371*** (−3.026)	−0.0825*** (−2.589)
Obs.	1967		1967	1589		1598	1598

Note: *t*-statistics are in parenthesis; (**, ***) denotes significance at the 0.10 (0.05, 0.01) level.

GED. The results of this estimation say that alcohol policies do not affect the probability of dropping out of school. However the MLDA regime of 18 does affect whether an individual will graduate with a GED rather than a high school diploma. In particular, the marginal effect of the variable MLDA18 evaluated at the mean of the independent variables indicates that being able to legally buy alcohol at the age of 18 reduces the probability of graduating from high school by 4 percentage points.

The second hypothesis of this study relates to alcohol consumption and age at graduation. Since alcohol bingeing increases the probability of receiving a GED diploma, and GED recipients tend to graduate late, one would expect bingeing to increase the time needed to complete 12 years of education. This hypothesis is tested in Column 3 of Table 3. The results refer to a probit estimation of the probability that an individual will complete the 12th year of education on time (i.e. by the age of 19), one year after the respondent answered the alcohol related question. As before, the alcohol policy variables are used to determine if alcohol consumption has a negative effect on educational attainment. The previous analysis showed that alcohol consumption does not affect the dropout rate measured at the age of 25, hence dropouts will be deleted from the sample. Also, only MLDA18 will be used as a proxy for bingeing, since it was the only significant alcohol policy variable in the previous estimations. As expected, MLDA18 is found to affect the probability that a person will graduate on time. In fact, raising the MLDA above 18 increases the probability that a person will graduate by the age of 19 by 5.3 percentage points.

The evidence that tougher MLDA policies have a positive effect on high school graduation rate indicates that heavy alcohol consumption has a negative effect on educational attainment. However, the previous estimations cannot say how big this effect is. Because BINGE was found to be endogenous, one needs a two-stage estimation procedure to be able to identify the direct effect of bingeing on the graduation rate. Column 4 of Table 3 reports the results of a two-stage probit estimation as explained in Maddala (1983, Chapter 8). As before, the analysis focuses only on the probability that a student will receive a high school diploma instead of a GED certificate, since alcohol consumption has no direct effect on the dropout rate. The first stage of the estimation is an OLS regression. Given that BINGE is discrete in nature one may object that a Poisson or a Negative Binomial estimation would be more appropriate. However, Heckman (1978, p. 947) argues that is not necessary to obtain consistent estimators of the IV estimation in order to consistently estimate the structural equation. Hence, Heckman recommends using OLS since it is the simplest procedure.⁶ In light of this result, many studies have used an OLS

⁶Angrist (2001) uses several linear and non linear two-step procedures to estimate the first stage of a two-probit model. He concludes that OLS is no less appropriate than other procedures if the covariates are sparse or discrete. The endogenous variable in this paper is not a dummy variable and no study has looked at count data endogenous variables. However one could extend Angrist's results to this paper. Since the only continuous variables in the model are AFQT, parents' education, and family income, one can assume that there is no loss from using OLS in the first stage.

regression to estimate the first stage of a two-stage probit (Bray, 2005; Chatterji & DeSimone, 2005; Dee & Evans, 2003). The results of the first stage estimation indicate that movements away from a MLDA18 were effective in reducing alcohol bingeing as the frequency of monthly episodes of bingeing decreased by 0.32. The results of the second stage estimation confirm that bingeing has a negative effect on educational attainment. More specifically, one additional episode of bingeing per month reduced the probability of receiving a high school diploma by 8 percentage points.

The precision of the two-stage estimation, however, depends heavily on the power of the instrumental variable. Bound, Jaeger, and Baker (1995) first showed that if the instrumental variable is a weak identifier of the endogenous variable, the two-stage estimation may not be superior to a naïve regression that does not try to control for the endogeneity. Staiger and Stock (1997) illustrate a simple test of the power of an instrumental variable based on the F -statistic of the hypothesis that the instrumental variable has a coefficient equal to zero in the first stage regression. If the F -statistic is less than 10, the instrumental variable is weak. While the coefficient on MLDA18 is significant at the 5 percent confidence level, the F -statistic equation for the hypothesis that MLDA18 does not enter the BINGE equation is only 3.92. Hence the results of a naïve probit estimation, where the variable BINGE is treated as exogenous, are reported for comparison in the last column of Table 3. The estimation results show again a negative effect of alcohol abuse on the probability of receiving a high school diploma, although the marginal effect of BINGE is about two percentage points smaller in the probit estimation than in the two-stage probit. Because of the endogeneity of the BINGE variable or the weakness of MLDA18 one should look at these results with caution. However they are consistent with the rest of the paper, since they indicate that alcohol bingeing has a negative effect on the probability of graduating from high school rather than earning a GED.

6. Conclusions

The clinical literature on alcohol abuse has found that heavy drinking negatively affects cognitive abilities. One would expect, therefore, that drinking should decrease the level of educational attainment. Still, some economic literature has failed to find such a negative effect. Traditionally, schooling has

been measured in terms of numbers of years of completed education. This means that both the high school diploma and the GED are recorded as 12 years of education. This paper shows that the negative effect of drinking cannot be elicited by using this measure of educational attainment, since drinking has no effect on the dropout rate. However, when estimating the probability of graduating from high school conditional on having 12 years of completed education, this research finds that tougher alcohol policies had a positive effect on the probability that an individual received a high school diploma rather than a GED certificate. Because teens' alcohol consumption is curbed by alcohol policies, this research concludes that abusive drinking decreases the probability of receiving a high school diploma and increases the probability of graduating with a GED. This result is confirmed by estimations based on a two-stage probit model and a naïve probit model.

These results have important implications for the analysis of the cost of drinking. Alcohol can negatively affect earnings in two ways. Drinking may decrease earnings because it affects a worker's productivity. This is the direct effect of substance abuse on earnings. However, earnings for heavy drinkers may also be lower because alcohol decreases their level of human capital acquisition. This is the indirect effect of alcohol on earnings. Previous studies have found that alcohol does not affect the number of years of completed education; therefore they conclude that there is no negative indirect effect of drinking on earnings. This paper, instead, reveals that there is a negative indirect cost of drinking, but it is not in the direction that was examined by previous studies. There is solid evidence that GED graduates have earnings indistinguishable from high school dropouts. Since abusive drinking decreases the probability of graduating from high school, and GED graduates earn less than high school graduates, this paper concludes that abusive drinking does have a negative indirect effect on earnings.

Most of the current literature, including this paper, concludes that heavy drinking does not affect the level of dropout at age 25. However, some research has found a positive effect of bingeing on the dropout rate measured at a younger age. This research offers an explanation for this result: alcohol abuse decreases the probability of graduating on time. DeSimone and Wolaver (2005) found that alcohol consumption has a negative effect on

school performance. Poor school performance may be one of the reasons for dropping out of school. Sometimes high school dropouts try to complete their degrees later on. However, instead of returning to school, dropouts may prefer to finish their studies by taking a GED exam.

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