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Reply

The minimum legal drinking age and marijuana use: New estimates from the NLSY97

Benjamin Crost*, Daniel I. Rees

Department of Economics, University of Colorado Denver, CO, United States

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ABSTRACT

In volume 30, issue 4 of this journal Barış Yörük and Ceren Yörük (Y&EY) used data from the National Longitudinal Study of Youth, 1997 (NLSY97) and a regression discontinuity design to estimate the effect of the minimum legal drinking age on a variety of substances including marijuana. They obtained evidence that the probability of marijuana use increased sharply at the age of 21, consistent with the hypothesis that alcohol and marijuana are complements, but inadvertently conditioned on having used marijuana at least once since the last survey. Applying the Y&EY research design to all NLSY97 respondents ages 19 through 22, we find no evidence that alcohol and marijuana are complements.

1. Introduction

A number of studies have found evidence of complementarity between alcohol and marijuana (DeSimone, 1998; Farrelly et al., 1999; Williams et al., 2004), while others lend support to the hypothesis that alcohol and marijuana are substitutes (Chaloupka and Laixuthai, 1997; DiNardo and Lemieux, 2001; Anderson et al., forthcoming). Two recent studies published by the *Journal of Health Economics* employed a regression discontinuity design to examine the effect of the minimum legal drinking age on marijuana use, but came to different conclusions. Drawing on data from the National Survey of Drug and Health for the period 2002–2007, Crost and Guerrero (2012) found that turning 21 was associated with a sharp decrease in marijuana use, consistent with the hypothesis that alcohol and marijuana are substitutes. Drawing on data from the National Longitudinal Study of Youth, 1997 (NLSY97) for the period 2000–2006, Yörük and Yörük (2011, p. 741) found "some evidence" that turning 21 was associated with a sharp increase in marijuana use, consistent with the hypothesis that alcohol and marijuana are complements.

In this comment, we reexamine the relationship between the minimum legal drinking age (MLDA) and marijuana use in the NLSY97 using a regression discontinuity design. Although we do not have exact date of birth, we are able to closely reproduce Y&EY's estimates, but only when we condition on having used marijuana since the last survey. When we use the full sample to examine the relationship between the MLDA and marijuana use, we find no evidence that alcohol and marijuana use are related.

2. Measuring marijuana use and the empirical model

NLSY97 respondents are asked a series of questions with regard to marijuana use, including: "Since the date of last interview, have you used marijuana, even if only once, for example: grass or pot?" Respondents who answer this question in the affirmative are then immediately asked: "On how many days have you used marijuana in the last 30 days?"

Y&EY appear to have inadvertently ignored the first of these two questions, in effect restricting their sample to respondents who had used marijuana at least once since they were last interviewed.[1] They focused on estimating the following equation for respondents

[1] One indication that Y&EY conditioned on marijuana use since the last survey is that their sample size fell by approximately 20,000 when they transitioned from estimating the relationship between the MLDA and demographic outcomes such as educational attainment to estimating the relationship between the MLDA and marijuana use in the past 30 days. Another indication is that almost 76% of their sample reported that they used marijuana the past 30 days, a figure that is inconsistent with what we know about marijuana use from other studies (DeSimone, 1998; DeSimone and Farrelly, 2003; Compton et al., 2004). Y&EY also estimated the effects of turning 21 on alcohol and tobacco use.

* Corresponding author. Tel.: +1 510 725 2086.
E-mail address: ben.crost@gmail.com (B. Crost).

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ages 19 through 22:

$$\text{MarijuanaUse}_i = \beta_0 + X_i'\beta_1 + \delta T_i + \alpha_1 \text{Age}_i + \alpha_2 \text{Age}_i^2 + \alpha_3(T_i \times \text{Age}_i) + \alpha_4(T_i \times \text{Age}_i^2) \quad (1)$$

where MarijuanaUse_i is equal to 1 if respondent i used marijuana in the past 30 days, and is equal to 0 otherwise; the vector X_i includes household income, educational attainment, marital status, gender, race, and student status, and employment status; and T_i is equal to 1 if the respondent had turned 21 by the interview date, and equal to 0 otherwise. Age_i is the respondent's age in days relative to his/her 21st birthday,[2] which was interacted with T_i to allow for flexible age trends above and below the age of 21. Y&EY found that turning 21 was associated with a 0.066–0.073 increase in the probability of marijuana use in the past 30 days, but this result is potentially misleading because they excluded respondents who had not used marijuana since their last interview.[3]

Below, we estimate Eq. (1) using data from the publicly available version of the NLSY97 for the period 2000–2006. Following Y&EY, our focus is on NLSY97 respondents ages 19 through 22. We begin by providing estimates that condition on having used marijuana since the last interview, and then provide unconditional estimates. Because we do not know exact date of birth, we calculate Age_i as the respondent's age in months relative to the month of his/her 21st birthday and exclude respondents who turned 21 the month they were interviewed.[4] Crost and Guerrero (2012) excluded respondents who turned 21 the month they were interviewed to "avoid measuring the effect of the (anticipated) birthday celebration" (p. 115). Following Y&EY, all of our regressions use NLSY sample weights.

3. Results

Columns 1 and 2 of Table 1 report estimates of Eq. (1) conditioning on having used marijuana since the last interview. Without controls on the right-hand side of the estimating equation, turning 21 is associated with 0.069 increase in the probability of marijuana use; with controls on the right-hand side, turning 21 is associated with a 0.075 increase in this probability. Both of these estimates are statistically significant at the 10% level and are similar in magnitude to those reported by Y&EY.[5]

Columns 3 and 4 of Table 1 report estimates of Eq. (1) based on the full sample. Although positive, these estimates are approximately 5 times smaller than those reported by Y&EY and are not statistically significant at conventional levels.[6] The mean of the dependent variable is 0.191, consistent with levels of marijuana use by young adults reported in previous studies such as DeSimone (1998), DeSimone and Farrelly (2003), and Compton et al. (2004).

Fig. 1 presents these results graphically. The scatter dots correspond to the mean of marijuana use by month of age, and the solid lines are quadratic fits estimated separately on both sides of age 21. The left panel of Fig. 1 shows a discontinuous increase in marijuana use at the age of 21 conditional on having used marijuana in since the last interview. However, when we include all respondents ages 19 through 22 in the analysis, the increase in marijuana use at the age of 21 is barely perceptible (Fig. 1, right panel).

In Table 2 we explore whether the estimates discussed above are sensitive to replacing the quadratic age trend with a linear, cubic,

Table 1
Comparison of conditional and unconditional results.

	Dependent variable: used marijuana in past 30 days			
	(1) Conditional on use in past year	(2)	(3) Unconditional	(4)
Age>21 (τ_{RD})	0.069*	0.075*	0.011	0.017
	(0.040)	(0.040)	(0.019)	(0.019)
Age	0.003	−0.004	−0.021	−0.022
	(0.062)	(0.062)	(0.030)	(0.029)
Age^2	−0.004	−0.007	−0.004	−0.005
	(0.029)	(0.029)	(0.014)	(0.014)
Age × Age>21	−0.120	−0.112	−0.016	−0.018
	(0.090)	(0.089)	(0.041)	(0.040)
Age^2 × Age>21	0.051	0.060	0.015	0.020
	(0.043)	(0.043)	(0.019)	(0.018)
Constant	0.755***	0.835***	0.190***	0.254***
	(0.028)	(0.034)	(0.014)	(0.018)
Mean	0.757	0.757	0.191	0.191
	(0.006)	(0.006)	(0.003)	(0.003)
Controls	No	Yes	No	Yes
Observations	6551	6551	28,089	28,089

Data source: NLSY97, 2000–2006. The sample contains all individuals ages 19 through 22, except individuals who turned 21 in the month of the interview. Control variables are: gross household income and indicators for being female, married, currently enrolled in college and four education levels (high school graduate, GED, some college, college graduate). Standard errors are clustered at the individual level. All regressions use NLSY sample weights. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 2
Robustness to different specifications.

Parametric models		Non-parametric models	
Linear	0.0026	Bandwidth = 60	0.015
	(0.012)		(0.028)
Quadratic	0.017	Bandwidth = 120	0.030
	(0.019)		(0.043)
Cubic	0.0098	Bandwidth = 240	0.0031
	(0.028)		(0.026)
Quartic	−0.0023	Bandwidth = 480	0.011
	(0.039)		(0.017)

Data source: NLSY97, 2000–2006. Reported figures are RD estimates of the discontinuous increase of marijuana consumption at age 21. Parametric models are based on the sample of all individuals ages 19 through 22, except individuals who turned 21 in the month of the interview. Non-parametric models are based on local linear regressions that use triangular kernels with bandwidths of 480, 240, 120 and 60 days. All regressions use NLSY sample weights and include the control variables listed in Table 1. Standard errors are clustered at the individual level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

[2] This normalization ensures that the parameter δ in Eq. (1) can be directly interpreted as the increase in marijuana use at age 21.

[3] Suppose, for example, that the majority of occasional users of marijuana stop altogether when they gain legal access to alcohol, while regular users of marijuana continue to use marijuana at least once a month. Then, conditioning on marijuana use in the past year would disproportionately discard respondents over the age of 21 who were occasional users from the analysis. As a result, estimates based on a regression discontinuity design could show a positive association between the MLDA and marijuana use despite the fact that marijuana use actually decreased.

[4] Because Y&EY had access to the confidential version of the NLSY97, they were able to accurately calculate T_i even if the respondent turned 21 the month they were interviewed.

[5] Without controls, Y&EY found that turning 21 was associated with a 0.066 increase in the probability of marijuana use; with the controls, turning 21 was associated with a 0.073 increase in this probability. Y&EY's estimates are based on 6975 observations. The conditional estimates in Table 1 are based on 6551 observations because we exclude respondents who turned 21 the month they were interviewed from our analysis. Y&EY also examined the relationship between turning 21 and the number of days in the past month marijuana was used. Because they found little evidence that turning 21 was associated with this outcome, we focus on marijuana use in the past 30 days (yes/no).

[6] Consistent with the estimates of Y&EY, we find no evidence that turning 21 has an effect on the number of days in the past month marijuana was used.

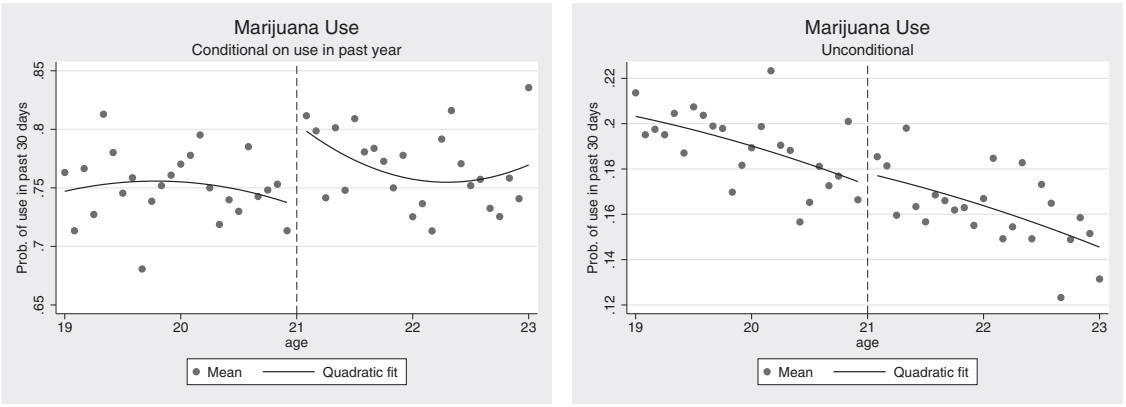

Fig. 1. Comparison of conditional and unconditional results. Data source: NLSY97. Scatter points denote means by month of age. Lines are quadratic fits, estimated separately on both sides of age 21.

or quartic age trend. In addition, we explore whether they are sensitive to using a non-parametric model with a triangular kernel and a variety of bandwidths. The estimated increase in marijuana use at age 21 is small and never statistically significant at conventional levels.

4. Conclusion

Using data from the confidential version of the NLSY97 and a regression discontinuity design, Yörük and Yörük (2011, p. 741) found, "under certain specifications," that the use of marijuana increased sharply at the age of 21. This result is consistent with the hypothesis that marijuana and alcohol are complements and, if correct, would have important policy implications.

In this comment we provide evidence that the increase in marijuana use at the age of 21 found by Yörük and Yörük (2011) is dependent upon restricting the sample to NLSY97 respondents who used marijuana since their last interview. Applying the same regression discontinuity design as used by Yörük and Yörük (2011) to all respondents 19 through 22 years of age, we find no evidence that marijuana use changes at age 21. In contrast, using data from the National Survey of Drug Use and Health (NSDUH), Crost and Guerrero (2012) documented a sharp decrease in marijuana use at the age of 21. One explanation for why Crost and Guerrero (2012) found evidence that marijuana and alcohol are substitutes while we find no evidence of a relationship between these substances is that there is more underreporting and measurement error in the NLSY97 substance use variables than in the NSDUH substance use variables. The NSDUH was specifically designed to cover the sensitive topic of substance use, which should in theory reduce measurement error and make the data better-suited for detecting changes in substance use over time.

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