The Impact of Raising the Minimum Legal Drinking Age on Academic Achievement and Risky Behaviour: A Difference-in-Discontinuities Approach

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Motivation

- Role of health and academic achievement (Grossman 2000; Case et al 2005; Currie 2009)
- Limits on adolescents' access to alcohol improve schooling behaviour and academic performance. (Carpenter and Dobkin 2009; Lindo et al 2016)
- Few evidence of reforms outside the US, and of younger teens
- Less is known on unintended behavioural changes (*Gateway Effect*) of alcohol initiation (Dee and Evans 2003; Crost and Rees 2013; Deza 2015) and roles of peer network.

Our paper

Research Questions

- Estimate causal effect of limiting access/initiation to alcohol on test scores
- Mechanisms via changes in own substance use, and peer risky behaviours

Identification approach

- Exploit an increase of the Minimum Legal Drinking Age (MLDA) from 16 to 18 years old, in 3 Spanish regions
  - **Treated**: Teens who turn 16 yr just after the regional reform $\rightarrow$ no more alcohol access.
  - **Control**: $<$16 (any time) & 16+ (before)
- Difference-in-discontinuities design (Grembi, Nannicini, Troiano 2016)
- Age threshold around **age 16** (age by month)
- Survey data of cohorts before & after the MLDA reform

Literature Review

- Evaluation MLDA with Regression Discontinuity Design (Carpenter and Dobkin 2009; Carrell et al 2011; Lindo et al 2016)
- Gateway effect to other substance use (Crost and Guerrero 2012; Crost and Rees 2013; Deza 2015)
- Gender differential: education (Lindo et al 2016; Carpenter and Dobkin 2009); gateway (Dee and Evans 2003)
- MLDA and education in Spain: Bagues and Villa (2025) using TWFE.

Recent reforms of MLDA in Spain

- Until 1987, MLDA in Spain was **16** years old (nationally)
- Region-specific reforms began in late 1990s: MLDA goes up to **18** years old (European standard)
  - **Treated**: Teens who turn 16 just after the regional reform $\rightarrow$ no more alcohol access.
  - **Control**: Teens <16 (any) & $16+$ (earlier cohorts)

- Due to unavailability of PISA and ESTUDES data before 2000...
- $\rightarrow$ Focus on **three late regions** (post-2000) are:
  - Castilla-León (March 2007)
  - Galicia (Februry 2011)
  - Asturias (May 2015)

Difference-in-Discontinuities Design

(Grembi, Nannicini, Troiano 2016)

$$
\begin{aligned}
Y_{it} = & \alpha_1 \cdot 1\{b_i \geq 0\} + \alpha_2 \cdot 1\{b_i \geq 0\} \cdot post_t \\
& + g(b_i) + \gamma_s + \eta_{st} + \beta X_i + v_{it}
\end{aligned} \tag{1}
$$

where

- Y_{it}: of teenager i, observed in survey t
- $1\{b_i \geq 0\}$: 1 if age-by-months (b) is 16 or above, 0 otherwise
- $post_t$: 1 if a survey is *after* the MLDA reform
- $g(b_i)$: polynomial of age-by-months
- Controlling for region FE (γ_s), region-year FE(η_{st}), individual characteristics (X_i) (gender, parent's education, native)

Main datasets

PISA Spain

- Years: 2003, 2006, 2009, 2015, 2018, 2022
- Age-by-months at test time (15-16); region of residence
- Test scores (std): maths, reading, science
- Schooling behaviour: sociability, truancy (skip school, skip class, lateness)

ESTUDES (Survey on drug use in secondary schools in Spain)

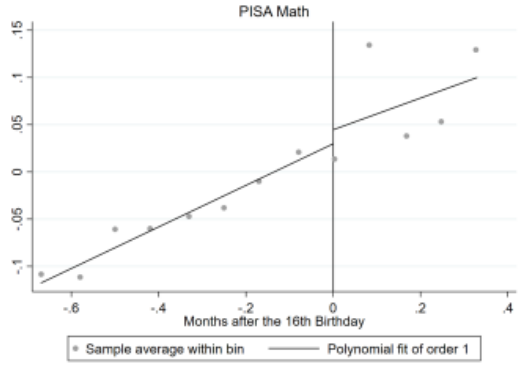
- Years: 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2019, 2021
- Age-by-months at survey (14-18); region of residence
- Own consumption: alcohol, intoxication, tobacco; illicit drugs
- Peer group's risky behaviours (share)

▸ data details

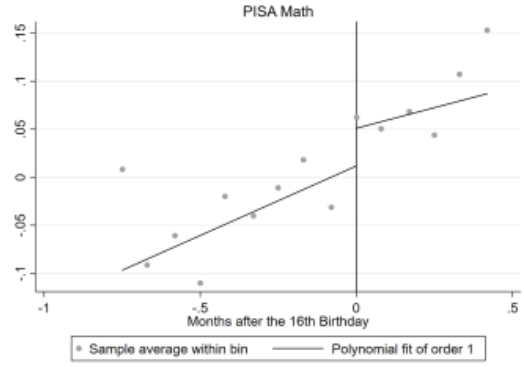
Validity Checks: RDD and Diff-Disc

- Optimal bandwidths using MSE and MSE-bias-estimator (Calonico et al 2014; Calonico et al 2017) $\longrightarrow$ **2 and 5 months**
- No bunching around the threshold age (16.0 yr) (McCrary 2008)
  ▸ histogram
- Sample is *balanced* around the threshold age (Grembi, Nannicini, Troiano 2016; Takahashi, 2024)
  - Option 1. H_0: no additional difference in each pre-determined variable between the sample groups below and above the age threshold, **after** the reform ▸ PISA ▸ ESTUDES
  - Option 2 (stricter). H_0: No difference between the groups below and above the threshold, **before and after** the reform

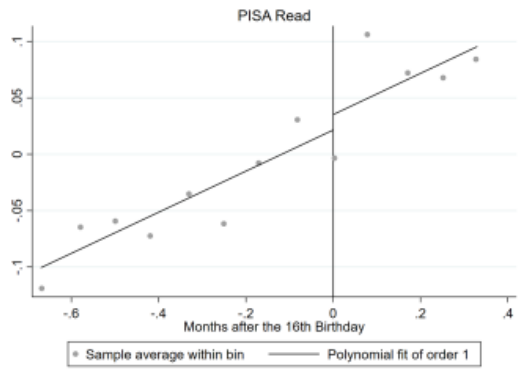
Graphical Results: PISA Scores w. Discontinuity at Age 16



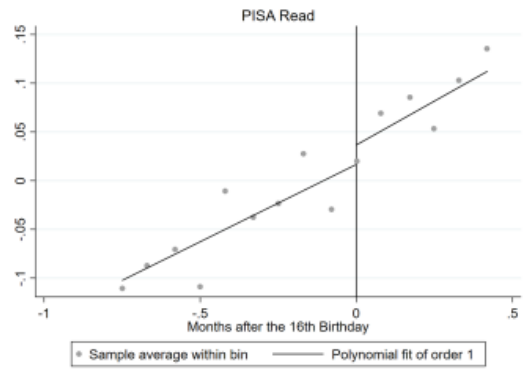
(a) Maths before MLDA



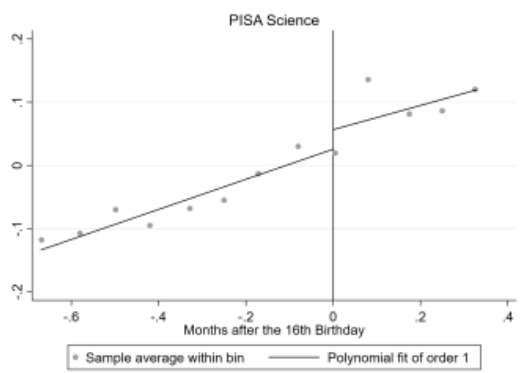
(b) Maths after MLDA



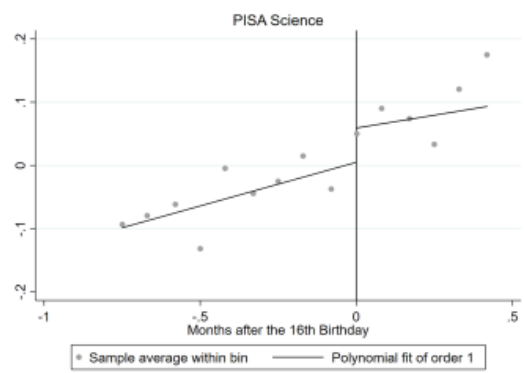
(c) Reading before MLDA



(d) Reading after MLDA



(e) Science before MLDA



(f) Science after MLDA

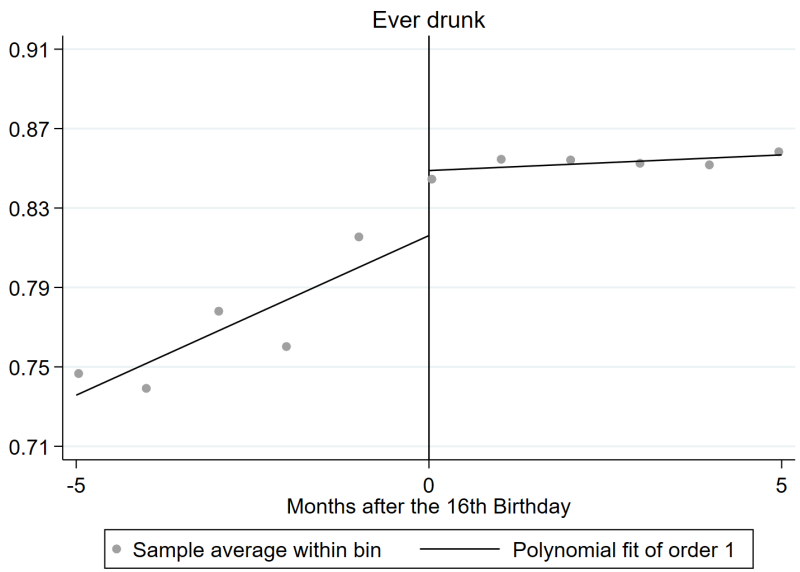
PISA: Test scores (bandwidth=2 mth, linear)

	Full	Female	Male	Low-Edu	High-Edu
	(1)	(2)	(3)	(4)	(5)
Panel A: Maths (std)					
Above threshold	0.026	0.113*	-0.058	-0.004	0.098**
	(0.040)	(0.047)	(0.032)	(0.048)	(0.025)
Above X post MLDA	0.071	-0.058	0.193**	0.155**	-0.029
	(0.044)	(0.046)	(0.053)	(0.052)	(0.041)
Panel B: Reading (std)					
Above threshold	-0.017	0.050**	-0.070***	-0.046	0.042***
	(0.019)	(0.017)	(0.017)	(0.030)	(0.009)
Above X post MLDA	0.058	-0.049**	0.145**	0.114	-0.010
	(0.033)	(0.015)	(0.054)	(0.058)	(0.023)
Panel C: Science (std)					
Above threshold	0.001	0.066	-0.055**	-0.011	0.040
	(0.030)	(0.039)	(0.021)	(0.032)	(0.031)
Above X post MLDA	0.093**	-0.037	0.210***	0.110	0.062
	(0.024)	(0.028)	(0.048)	(0.056)	(0.034)
Obs	14974	7489	7485	7316	7658

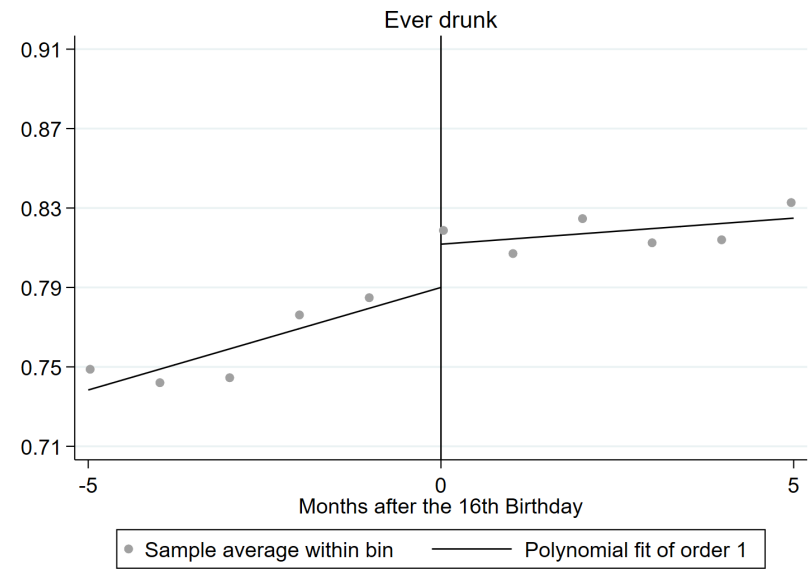
PISA: Schooling behaviours

	Full	Female	Male	Low-Edu	High-Edu
	(1)	(2)	(3)	(4)	(5)
A: Sociability index					
Above X post MLDA	-0.086**	0.067**	-0.233***	-0.079	-0.098***
	(0.023)	(0.018)	(0.042)	(0.052)	(0.019)
B: Truant - Skip school					
Above X post MLDA	-0.219**	-0.142**	-0.271**	-0.228**	-0.221**
	(0.065)	(0.044)	(0.075)	(0.063)	(0.068)
C: Truant - Skip classes					
Above X post MLDA	-0.179***	-0.230***	-0.122*	-0.108	-0.291***
	(0.018)	(0.041)	(0.054)	(0.058)	(0.041)
D: Truant - Late for school					
Above X post MLDA	0.064	0.078	0.023	0.146	-0.264**
	(0.069)	(0.103)	(0.123)	(0.088)	(0.095)
Obs	7604	3859	3745	2554	5050

Graphical Results: ESTUDES and Alcohol Consumption



before MLDA



after MLDA

ESTUDES: Own drinking & intoxication

	Full	Female	Male	Low-Edu	High-Edu
	(1)	(2)	(3)	(4)	(5)
A: Ever drink alcohol					
Above X post MLDA	-0.038**	-0.017	-0.066***	-0.103***	0.051**
	(0.012)	(0.039)	(0.013)	(0.023)	(0.020)
B: Drank in the past month					
Above X post MLDA	0.011	0.006	0.016	0.035	-0.038
	(0.026)	(0.024)	(0.038)	(0.032)	(0.043)
C: Drink weekly					
Above X post MLDA	-0.036	0.005	-0.069	-0.008	-0.098**
	(0.025)	(0.035)	(0.035)	(0.028)	(0.037)
D: Ever been intoxicated					
Above X post MLDA	-0.021	0.018	-0.036	0.045	-0.113**
	(0.042)	(0.021)	(0.061)	(0.052)	(0.042)
E: Intoxication in the last month					
Above X post MLDA	-0.076***	-0.104**	-0.028	-0.084**	-0.055
	(0.017)	(0.038)	(0.020)	(0.029)	(0.043)
F: Frequency of intoxication in the last month					
Above X post MLDA	-0.156**	-0.141*	-0.115	-0.184***	-0.095
	(0.046)	(0.065)	(0.083)	(0.042)	(0.063)

ESTUDES: Own tobacco & cannabis

	Full	Female	Male	Low-Edu	High-Edu
	(1)	(2)	(3)	(4)	(5)
A: Ever smoked					
Above X post MLDA	-0.080**	-0.066	-0.085**	-0.107**	-0.047
	(0.028)	(0.053)	(0.026)	(0.034)	(0.048)
B: Smoked in the last month					
Above X post MLDA	0.041	-0.209	0.321	-0.247	0.277
	(0.615)	(0.373)	(0.883)	(0.494)	(0.651)
C: No. cigarettes smoked daily					
Above X post MLDA	0.026	-0.087	0.190	-0.086	0.046
	(0.177)	(0.235)	(0.212)	(0.193)	(0.236)
D: Ever took marijuana					
Above X post MLDA	-0.034	-0.011	-0.043**	-0.016	-0.049
	(0.020)	(0.027)	(0.014)	(0.029)	(0.043)
E: Took marijuana in the last year					
Above X post MLDA	-0.045**	-0.015	-0.062***	-0.033**	-0.066
	(0.017)	(0.029)	(0.015)	(0.010)	(0.043)
F: Took marijuana in the last month					
Above X post MLDA	-0.048	-0.032	-0.058	-0.025	-0.090*
	(0.045)	(0.043)	(0.052)	(0.056)	(0.038)
G: Took marijuana first time by age 16					
Above X post MLDA	-0.032	-0.022	-0.029*	-0.022	-0.037
	(0.016)	(0.025)	(0.014)	(0.022)	(0.043)

ESTUDES: Peer group's risky behaviours

	Full	Female	Male	Low-Edu	High-Edu
	(1)	(2)	(3)	(4)	(5)
A: Drink alcohol					
Above X post MLDA	-0.187***	-0.141**	-0.258***	-0.211***	-0.189**
	(0.025)	(0.047)	(0.029)	(0.033)	(0.061)
B: Smoking					
Above X post MLDA	-0.129**	-0.098*	-0.155*	-0.213**	-0.001
	(0.034)	(0.041)	(0.065)	(0.066)	(0.076)
C: Intoxication					
Above X post MLDA	-0.184***	-0.175*	-0.173**	-0.234**	-0.109
	(0.021)	(0.073)	(0.066)	(0.065)	(0.102)
D: Take marijuana					
Above X post MLDA	-0.123***	0.024	-0.237**	-0.153**	-0.079
	(0.027)	(0.041)	(0.064)	(0.044)	(0.042)
E: Take cocaine					
Above X post MLDA	-0.074**	-0.113**	-0.024	-0.096**	-0.036
	(0.023)	(0.030)	(0.034)	(0.025)	(0.053)
Obs	3561	1793	1766	2024	1536

Summary

- Our diff-in-disc specification deals better with other potential but unobserved changes associated with turning 16 years old.
- We identify the LATT effect at the discontinuity.
- Lifting MLDA improves test scores, esp. boys & teens from lower SES.
- MLDA directly reduces alcohol intake and intoxication
- Spillover effects to own consumption other illicit drugs whilst not tobacco
- With peer groups show reduction in risky behaviours – larger effects among boys & teens from lower SES

Thank you!

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Detail: Timing of MLDA, PISA & ESTUDES

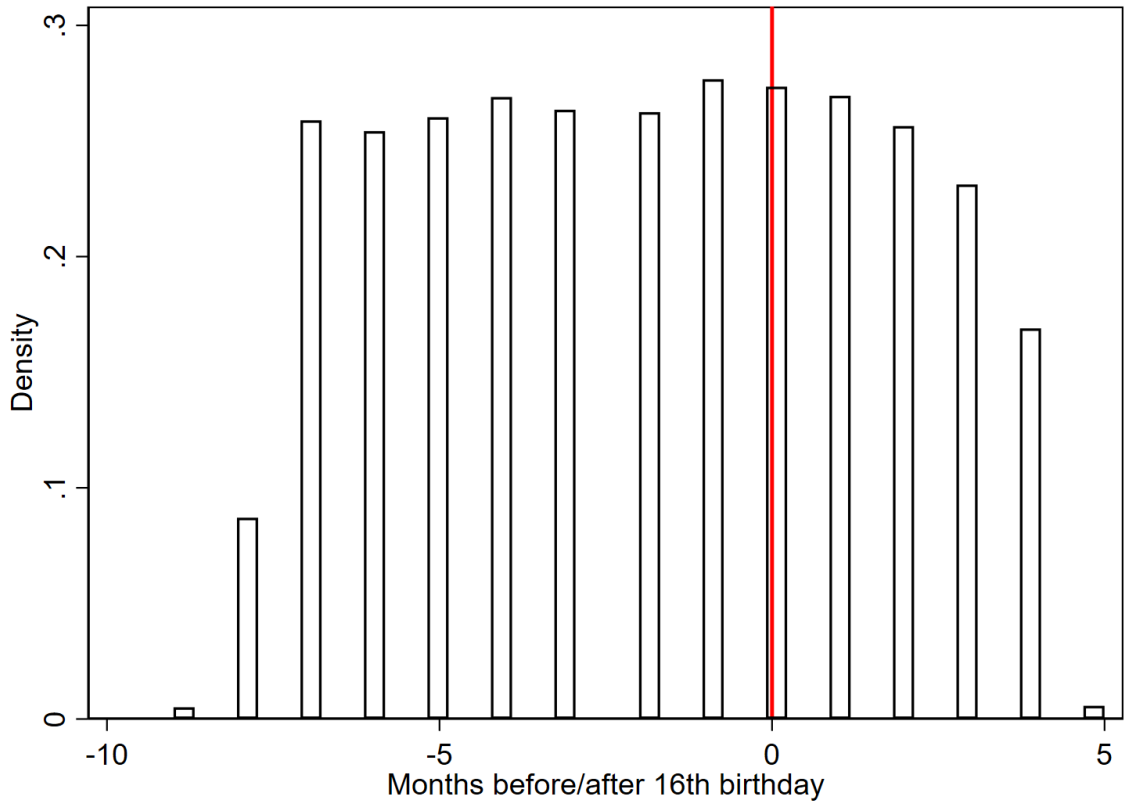
		PISA Waves						
MLDA Date	Autonomous Community	2003	2006	2009	2012	2015	2018	2022
20-May-15	Asturias	n/a	pre	pre	pre	pre/post	post	post
28-Feb-11	Galicia	n/a	pre	pre	post	post	post	post
15-Mar-07	Castilla-León	pre	pre	post	post	post	post	post

		ESTUDES								
MLDA Date	Autonomous Community	2004	2006	2008	2010	2012	2014	2016	2019	2021
20-May-15	Asturias	pre	pre	pre	pre	pre	pre	post	post	post
28-Feb-11	Galicia	pre	pre	pre	pre	post	post	post	post	post
15-Mar-07	Castilla-León	pre	pre	post	post	post	post	post	post	post

back

Validation 2. No bunching

Raw histogram relative age (months) around 16.



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Validation 3. Balanced Sample (PISA)

PISA: p-values reported of H_0: no additional difference in each pre-determined variable between the sample below and above the age threshold **after** the reform

Bandwidth	Female	Native		Parents		Books	Social-Cultural
		speaker	born	Education	Occupation		Status
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A. $g(b_i)$ of degree 3			
5 months	0.027	0.012	0.443	0.618	0.075	0.282	0.165
4 months	0.033	0.015	0.267	0.628	0.129	0.868	0.192
				Panel B. $g(b_i)$ of degree 2			
5 months	0.047	0.043	0.041	0.465	0.102	0.004	0.176
4 months	0.148	0.049	0.027	0.449	0.110	0.020	0.167
3 months	0.037	0.096	0.248	0.727	0.265	0.153	0.321
				Panel C. $g(b_i)$ of degree 1			
5 months	0.095	0.126	0.046	0.447	0.211	0.984	0.134
4 months	0.077	0.162	0.017	0.431	0.236	0.551	0.173
3 months	0.156	0.188	0.007	0.449	0.166	0.115	0.218
2 months	0.052	0.534	0.011	0.854	0.348	0.118	0.534

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Validation 3. Balanced Sample (ESTUDES)

ESTUDES: p-values reported of H_0: no additional difference in each pre-determined variable between the sample below and above the age threshold **after** the reform

Bandwidth	Female (1)	Native born (2)	Mother educ. (3)	Father educ. (4)	Mother employment (5)	Father employment (6)
			Panel A. $g(b_i)$ of degree 3			
5 months	0.381	0.732	0.202	0.018	0.070	0.356
4 months	0.410	0.954	0.238	0.055	0.045	0.463
			Panel B. $g(b_i)$ of degree 2			
5 months	0.434	0.445	0.874	0.028	0.281	0.277
4 months	0.447	0.570	0.254	0.042	0.133	0.280
3 months	0.480	0.816	0.197	0.239	0.248	0.586
			Panel C. $g(b_i)$ of degree 1			
5 months	0.247	0.585	0.449	0.184	0.209	0.293
4 months	0.386	0.310	0.487	0.067	0.231	0.228
3 months	0.692	0.494	0.943	0.278	0.745	0.229
2 months	0.447	0.504	0.513	0.311	0.652	0.777

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