The Long-Term Effects of Marijuana Use on Mental Health Outcomes

The X International Conference In Economics And Finance

European Humanities University and BEROC

December 2022

Outline

- Background

- The identification issue
  - The instruments
  - Manski's reflection problem
  - The psychology of bias and the economics of equilibrium

- Results
- Robustness checks

Background

- As of November, 39 states and Washington DC have legalized medical use of marijuana

- 21 states and Washington DC have legalized non-medical use of marijuana for adults

- Between 2008 and 2019, marijuana use in the US has almost doubled

Background

- Adolescent marijuana ever-use increased from 30.5% in 2016 to 32.4% in 2018

- Among 12th-graders in 2016, 22.5% used marijuana in the past 30 days; 36% ever used

- Many adolescents report relatively easy access to marijuana and perceptions that recreational use involves minimal harm

Health Effects

- The pleasurable effects of marijuana include relaxation, improved mood, and increased appetite

- Regular use is associated with depression, anxiety, panic disorder, cognitive and memory deficiencies, problems with perception of time and space

- Many associations disappear after controlling for environmental confounders

Background

- Most marijuana use is initiated in adolescence

- Peer influence

- Both observable behavior of peers, and (mis)perception of peers' behavior matter

Our Contributions

- We use Add Health - a large nationally representative sample of U.S middle and high school adolescents

- We estimate the effect of marijuana use in adolescence (ages 12-19) on mental health indicators twenty years later (ages 31-42)

- Instrument adolescent marijuana use with the adolescent's perceptions of use among friends and actual use of friends

Mental Health Outcomes (2016-2018)

- Indicator for depression

"Has a doctor, nurse, or other health care provider ever told you that you have or had depression?"

- Indicator for anxiety

"Has a doctor, nurse, or other health care provider ever told you that you have or had anxiety or panic disorder?"

- Suicidal thoughts or attempts

"During the past 12 months, have you ever seriously thought about committing suicide?" (or attempted suicide)

Explanatory Variables

- **Marijuana use** $=1$ if used marijuana at least once in the past month (from 1996)

- Controls (from 1994): Age; gender; race; ethnicity; picture Vocabulary Test (PVT) score; pretax family income; whether the adolescent lived with both biological parents; whether mother or father has a college degree; attendance of religious services; presence of older siblings; whether illegal drugs are easily available at home; age of the adolescent when moved to current location; whether the parents chose their residence because of the school; grade and school fixed effects

Instruments (measured in 1996)

1. Number of best friends whom the respondent *perceived* to be users: "Of your 3 best friends, how many use marijuana at least once a month?"

2. Proportion of *friends of friends* who use marijuana (as reported by friends-of-friends directly)

- IV assumption: After accounting for the 'correlated' effects with the use of individual-level covariates and school fixed effects, the only way actual and perceived peer use affects individual's future health outcomes is via individual's own use in adolescence

The two instruments are related

- Perkins H. W. (2014). Misperception is Reality: The Reign of Error About Peer Risk Behaviour Norms Among Youth and Young Adults.

Figure 1. Simple peer influence model of personal drug use
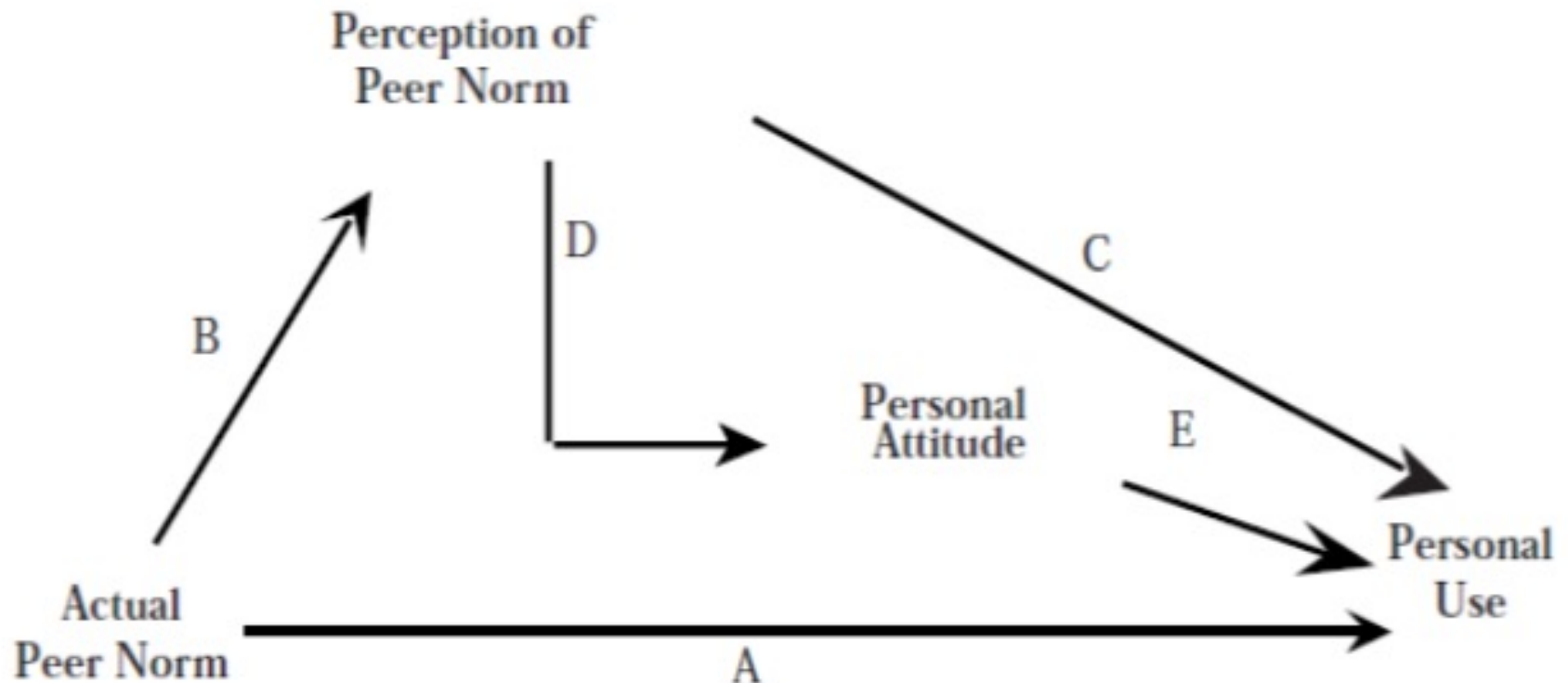
Both IVs: Reflection Problem

- Manski C.F. (2000). Economic analysis of social interactions. *Journal of Economic Perspectives* 14(3):115-136.

- Difficulties in identifying the causal link between the behavior of a reference group & an individual
  - Endogenous Effect
  - Exogenous (Contextual) Effects
  - Correlated Effects

Endogenous Peer Effect

- Measures how an individual's behavior is affected by the behavior of his/her peers
  - I will increase my marijuana use if my friends increase their marijuana use

- Used as a source of exogenous variation in IV

Exogenous (Contextual) Effects

- Response of individual's behavior to exogenous characteristics of the peer group
  - Examples: Older siblings affect younger siblings because substance use increases with age. Parental rules at friend's home that prohibit drug use affect my drug use through reduction in my friend's use.

- Used as a source of exogenous variation in IV

Correlated Effects

- When individuals within a specific group are similar or get selected as friends or when peers face the same environment that might cause them to act in a similar manner
  - Children in the same school might engage in drug use because of higher availability of drugs in the neighborhood.

  - Make instruments endogenous

 - Individual controls and school fixed effects

Theoretical effect of perceptual biases

- Cooter R.D., Feldman M., Feldman Y. (2008). The Misperception of Norms: The Psychology of Bias and the Economics of Equilibrium, *Review of Law & Economics*, 4(3):889-911.

- This cost-benefit framework of conformity to social norms implies that consumption of addictive substances will adjust in the direction of others-are-bad" bias in cases of under- and overestimation of social norm

The marginal benefit and cost of breaking the norm and the equilibria
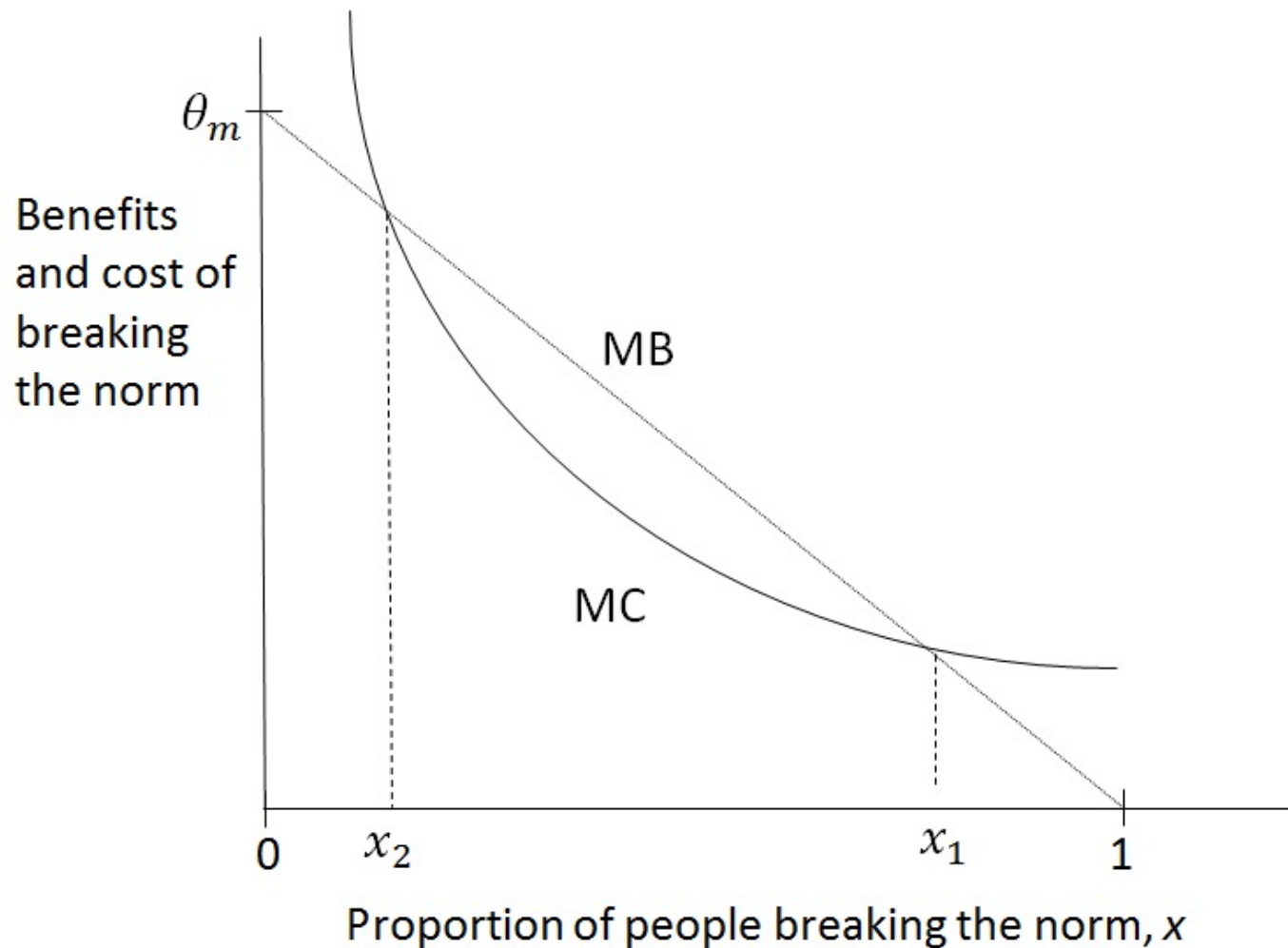
The effect of underestimation and overestimation of the norm on the equilibrium
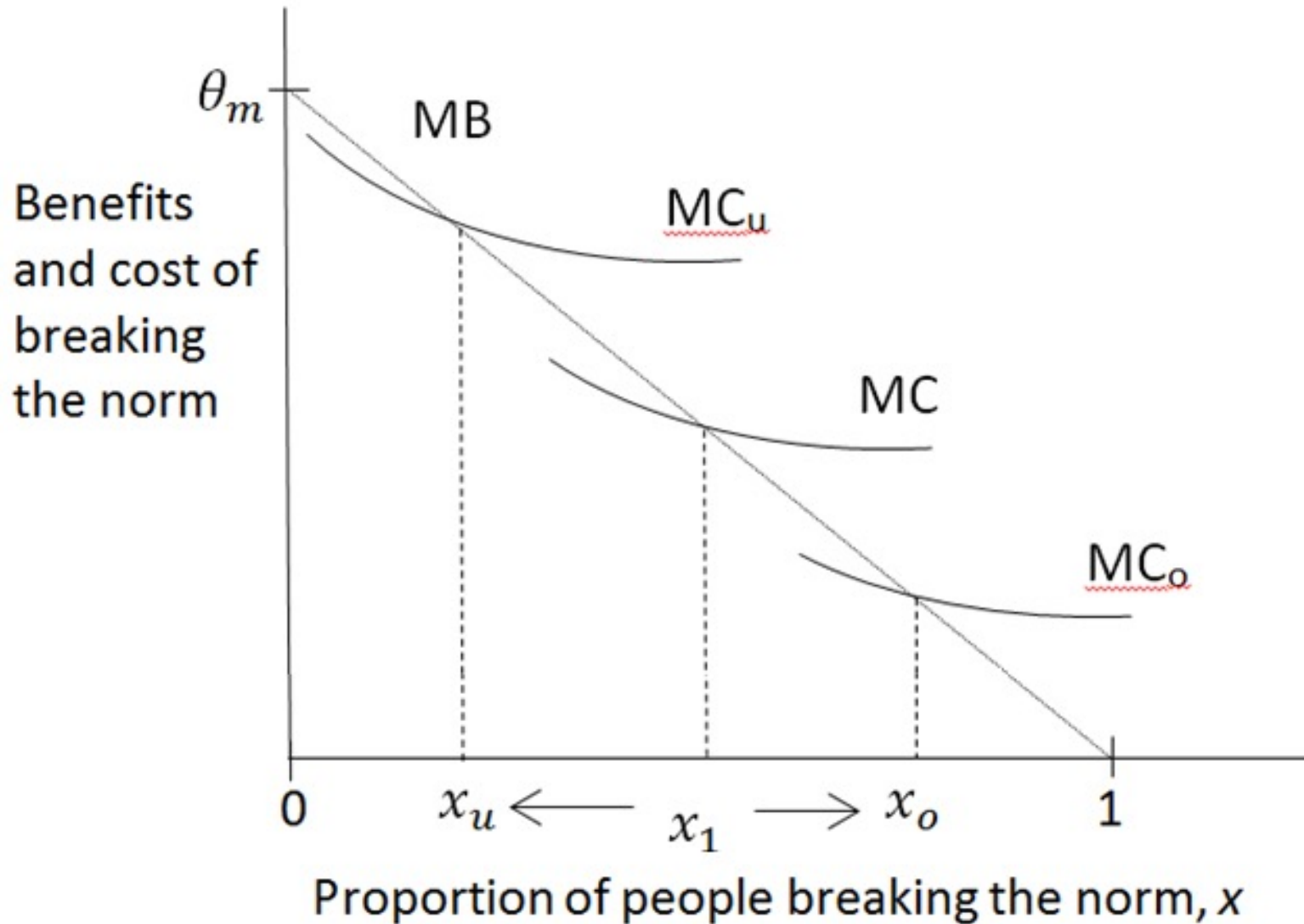
Marijuana use of peers is over-estimated

- Normative misperceptions may be induced by external factors such as observing a few peers engage in unusual and extreme behaviors

- They are often sensationalized in the media and amplified and perpetuated by social conversations

Descriptive statistics, N=12,128				
Variable	Mean	SD	Min	Max
Marijuana use, 1996	0.156	0.362	0	1
Regular marijuana use, 1996	0.0730	0.261	0	1
Perceived number of friends using marijuana, 1996	0.682	1.002	0	3
Average marijuana use of friends of friends, 1996*	0.154	0.252	0	1
Marijuana use, 2016–18	0.146	0.353	0	1
Depression, 2016–18	0.190	0.392	0	1
Anxiety, 2016–18	0.208	0.406	0	1
Suicidal ideation/attempts, 2016–18	0.0690	0.253	0	1

First stage regression for adolescent's own marijuana use in 1996, N=12,128.

	Coefficient	SE
Perceived number of friend users, 1996	0.201**	(0.005)
R squared	0.36	
F-test of instrument	1416.49	

* p<0.05, ** p<0.01. All controls included.

Coefficient on marijuana use in 1996 for outcomes measured in 2016-18, N=12,128				
	Marijuana use	Suicidal	Depression	Anxiety
OLS coefficient	0.19**	0.01	0.01	0.05**
2SLS coefficient	0.27**	0.04*	0.00	0.10**
* p<0.05, ** p<0.01. All controls included.				

Sub-sample and Sensitivity analyses

- *Sub-sample analysis*
  - By gender: anxiety only increased among females
- *Validity of the instruments*
  - Placebo 2SLS regressions for a range of outcomes which are unlikely to be affected by adolescent marijuana use (e.g. height, parental SES, health conditions before age 16)
  - Sensitivity to the inclusion of confounders (by gradually adding control variables to the model)
  - Used both instruments (actual use of friends and perception about friend use)

- *Sensitivity to a plausible violation of the exclusion restriction*
  - Allowed for possibility that the instruments have a direct effect on the outcome in the second-stage 2SLS equation

  - Estimated the bounds for the IV estimates using Conley's (2012) "Plausibly exogenous" approach (Stata "plausexog")

  - Used "zero-first-stage" sample (Kippersluis and Rietveld 2018) to obtain the estimates of the direct effect of instrument (as a plausible violation of the exclusion restriction) on the outcomes in the second-stage of 2SLS

- *Sensitivity to the definition of marijuana use in Wave II*
  - Set marijuana use indicator equal to one if the respondent used at least 4 times in the past 30 days: stronger effects

- *Sensitivity of the 2SLS specification*
- Kang H., Kreuels B., May J., Small D. S. (2016) Full matching approach to instrumental variables estimation with application to the effect of malaria on stunting. *The Annals of Applied Statistics*, 10(1), 335-364. (R package "matchIV")
- Isolated students who are comparable in 1996 (except IV)
- Compares the values of the outcomes between individuals with high and low values of the instrument within a matched set to assess the effect of marijuana use on the outcomes

Thank you!