

# Persistent Marijuana Use: Evidence from the NLSY

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ESEM, August 2023

# Objectives

Determine the magnitude and sources of persistence in marijuana consumption utilizing data from the 1997 cohort of the National Longitudinal Survey of Youth (NLSY97)

- pure state dependence (addiction)
- time invariant unobserved heterogeneity
- persistence in idiosyncratic, time-varying shocks

Distinguish between moderate and heavy consumption

Analyze transitions between different consumption patterns

# Motivation

For many, consumption is modest, occasional and highly transitory while others use marijuana on a regular and persistent basis

If there is a causal, addictive effect of marijuana use over time, any initiation is associated with a risk of continued, persistent use. In this case, policies that make marijuana consumption more accessible and socially acceptable may increase the risk of marijuana dependence

Important to understand the dynamics of marijuana consumption

The legal status of recreational marijuana in the US, and elsewhere, is changing

# Literature and contribution

Deza (2015) is one of very few studies on persistent marijuana consumption

She considers alcohol, marijuana and hard drugs and separate the contributions from state dependence and unobserved heterogeneity, within and between drugs

She finds significant “stepping-stone” effects into hard drugs

We allow for more general forms of dynamics as well as serially correlated utility shocks

We also separate occasional or experimental use from continuous, intensive use

We follow NLSY97 respondents from age 13 onward, minimizing left censoring

We create individual annual indicators of marijuana use (and non-use) as well as indicators for intensity of use, conditional on use, from multiple questions

In our sample, 3.7% used marijuana at least once at age 13. By age 16, this proportion increased to over 18%

We distinguish between moderate use (1-9 days per month) and heavy use (10 days or more)

# Transition matrix

	No (t)	Moderate (t)	Heavy (t)
No (t-1)	0.915	0.064	0.021
Moderate (t-1)	0.497	0.339	0.164
Heavy (t-1)	0.198	0.166	0.635

# Estimation

Let  $c_{i,t}^*$  denote latent, unobserved utility of marijuana consumption for individual  $i$  in period  $t$

$$c_{i,t}^* = \Psi_{i,t} + \gamma_1 \sum_{j=1}^t \delta^{j-1} \mathbf{1}(c_{i,t-1} = 1) + \gamma_2 \sum_{j=1}^t \delta^{j-1} \mathbf{1}(c_{i,t-1} = 2) + \sigma \mu_i + \varepsilon_{i,t}$$

$$i = 1, \dots, n; t = 1, \dots, T_i$$

$$\Psi_{i,t} = \mathbf{X}_i \beta + \kappa_1 (t - t_0) + \kappa_2 (t - t_0)^2$$

$$\delta \in [0, 1]$$

$$c_{i,0} = 0 \text{ for everyone.}$$

We assume that:

$\mu_i$  and  $\varepsilon_{it}$  are independent of  $X$  and across individuals.

$\mu_i$  is i.i.d.  $N(0, 1)$  and fixed over time

$\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + \nu_{i,t}$ , where  $\nu_{i,t}$  are i.i.d  $N(0, 1)$

Further,

$c_{i,t} = 0$  if the person did not use marijuana in period  $t$

$c_{i,t} = 1$  if the person used marijuana less than 10 days per month in  $t$

$c_{i,t} = 2$  if the person used marijuana 10 days or more per month in  $t$



The observed outcomes are determined as follows

$$c_{i,t} = \begin{cases} 0 & \text{if } c_{i,t}^* \leq \theta_1 \\ 1 & \text{if } \theta_1 < c_{i,t}^* \leq \theta_2 \\ 2 & \text{if } c_{i,t}^* > \theta_2 \end{cases}$$

where  $c_{i,0} = 0$  for everyone.

Given the stochastic assumptions and the assignment rule, the probabilities of observed outcomes are

$$Pr(c_{i,t} = 0 | c_{i,t-1}) = \Phi(\theta_1 - \lambda_{i,t}) = \Lambda_0$$

$$Pr(c_{i,t} = 1 | c_{i,t-1}) = \Phi(\theta_2 - \lambda_{i,t}) - \Phi(\theta_1 - \lambda_{i,t}) = \Lambda_1$$

$$Pr(c_{i,t} = 2 | c_{i,t-1}) = 1 - \Phi(\theta_2 - \lambda_{i,t}) = \Lambda_2$$

and the likelihood function is

$$\mathcal{L} = \sum_{i=1}^n \ln \left\{ \frac{1}{m} \sum_{j=1}^m \prod_{t=1}^{T_i} \Lambda_0^{I(c_{it}=0)} \Lambda_1^{I(c_{it}=1)} \Lambda_2^{I(c_{it}=2)} \right\}$$

## Selected estimates - binary outcomes

	(1)	(2)	(3)
Marijuana (t-1)	1.69	0.98	0.73
$\sigma$	-	0.85	0.41
$\rho$	-	-	0.22

## Selected estimates - ordered outcomes

	Estimate	Std err
Moderate (t-1)	0.432	0.047
Heavy (t-1)	0.786	0.051
Male	0.143	0.047
Intact family	-0.183	0.054
$\sigma$	0.569	0.060
$\rho$	0.300	0.025
$\theta_1$	1.735	0.182
$\theta_2$	2.556	0.186

# Average partial effects

	Moderate	Heavy
$P(m_t m_{t-1}) - P(m_t n_{t-1})$	0.046	-
$P(m_t m_{t-1}) - P(m_t h_{t-1})$	-0.051	-
$P(h_t h_{t-1}) - P(h_t n_{t-1})$	-	0.043
$P(h_t h_{t-1}) - P(h_t m_{t-1})$	-	0.027

# Sources of persistence

	Moderate	Heavy
Predicted persistence	0.254	0.598
$\sigma_u = 0$	0.173	0.355
$\sigma_u = \rho = 0$	0.156	0.255
$\sigma_u = \rho = \beta = \kappa_1 = \kappa_2 = 0$	0.118	0.196

# Summary

We provide new evidence on the persistence of marijuana use among American youth

This topic is important for many reason, one being the fact that marijuana consumption among teenagers is inversely related to many successful future labor market outcomes

We specify the dynamics of marijuana use in a flexible way and do not limit it to the inclusion of a one-period lag

We consider different intensity levels of marijuana consumption

## Summary, continued

The estimated average partial effects show that previous consumption significantly increase the probability of current consumption

These effects are severely exaggerated in models that ignores persistence in utility shocks and restricts the form of dynamics

The probability of consuming marijuana now increase by a factor of 1.5 when we change the status of previous consumption from none to moderate or heavy

Persistent unobserved heterogeneity and persistent time-varying random shocks both play a large role in overall persistence of marijuana consumption

Still, almost half of overall persistence in moderate consumption is causal, less so for heavy use (a third)