Internet Appendix to Spillover Effects of the Opioid Epidemic on Consumer Finance*

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Appendix A. Variable Definitions

This appendix reports definitions for the variables used in the analysis. Data were obtained as follows: loan data from an indirect auto financing firm; the unemployment rate from the U.S. Bureau of Labor Statistics; the yield spread from the Federal Reserve Bank of St. Louis; and the drug-related death rates from the Centers for Disease Control and Prevention (CDC).

- ALCOHOL_DEATH_RATE: Alcohol-induced cause of death per 100,000 persons for all races, both sexes, and all ages for the years 1999 to 2016.
  Accessed at at http://wonder.cdc.gov/mcd-icd10.html.

- DEFAULT: Indicator [with a value of 100] for termination of the loan due to default (i.e., failure to make payments).

- DOWN_PAYMENT: Represents the total down payment by the borrower, measured in $.

- DRUG_DEATH_RATE: Drug poisoning death rates per 100,000 persons for all races, both sexes, and ages 20 to 79 for the years 1999 to 2016. The data includes ICD-10 codes X40-X44, X60-X64, X85, and Y10-Y14.
  Accessed at at http://wonder.cdc.gov/mcd-icd10.html.

- FICO_SCORE: Mean of borrower's credit scores from all queried credit-reporting agencies.

- LABOR_FORCE_PARTICIPATION: Labor force participation rate, measured in %.

- MONTHLY_INCOME: Borrower's gross monthly income as calculated at loan underwriting, measured in $ '000s.

- PRIOR_BANKRUPTCY: Indicator for chapter 7 bankruptcy in the seven years prior to the loan application.

- POST_LEGALIZATION: Indicator for states that have (1) legalized recreational marijuana usage and (2) implemented operational and legally protected dispensaries.

- TAXABLE_MARIJUANA_SALES: Quarterly taxable marijuana sales in each state (or 0 otherwise), measured in $ millions.
- TERM: Original term of the contract, measured in months.
- TOTAL_LOAN_COST: The total loan cost, measured in $ '000s, represents (1) all payments of principal, interest, and fees made by the borrower to the lender, (2) the loss of value and costs associated with the repossession and sale of the vehicle, and (3) all payments made by the borrower arising from post-default collections efforts.
- TOTAL_PAYMENTS_TO_LENDER: Total loan payments received by the lender from the borrower, measured in $ '000s.
- UNEMPLOYMENT_RATE: Unemployment rate, measured in %.
- VEHICLE_BOOK_VALUE:Vehicle book value, measured in $ '000s.
- YIELD_SPREAD: Bank of America - Merrill Lynch U.S. corporate AAA–BBB option-adjusted spread at the time of origination, measured in %.

Appendix B. Other Regulatory Changes

Another possible explanation for the relation of opioid abuse and loan defaults is that an additional, separate change in regulations concurrently affected these measures. If this occurred, then the mechanism attributed to marijuana is incorrectly identified, but the relation between opioid abuse (as proxied by drug-related death rates) and loan defaults remains valid. One such change could be the 2014 adoption, by 12 states, of laws that limited initial opioid prescriptions to a 30-day supply. However, the medical literature provides no empirical evidence that these laws significantly affected opioid abuse or drug-related deaths. Another such change could be the passage of new prescribing rules for opioid drugs by Oregon and Washington.[13] Prior to 2017, however, Washington's last update to its opioid regulations was in 2011, three years before the state legalized recreational marijuana. Oregon did not pass any new opioid-related regulations in the year prior to or in the year immediately following its legalization of marijuana, though it did adopt (along with most other U.S. states) the CDC's advisory guidelines in 2016. To summarize, while there were a number of other legislative changes in the states that legalized recreational marijuana, these changes are unlikely to have caused the impact on opioid abuse (as proxied by drug-related death rates) and the resultant change in loan default rates that I observe. The absence of any new meaningful regulation of opioids in

[13]See for example, Washington ESHB 1427. For a comprehensive overview of state laws related to opioid-related policy, see the Arizona Department of Health Services' site: https://www.azdhs.gov/documents/prevention/womens-childrens-health/injury-prevention/opioid-prevention/50-state-review-printer-friendly.pdf.

these states suggests that another factor (e.g., marijuana legalization itself) explains the reduction in drug-related death rates following the legalization of recreational marijuana.

Appendix C. Supporting Figures and Tables

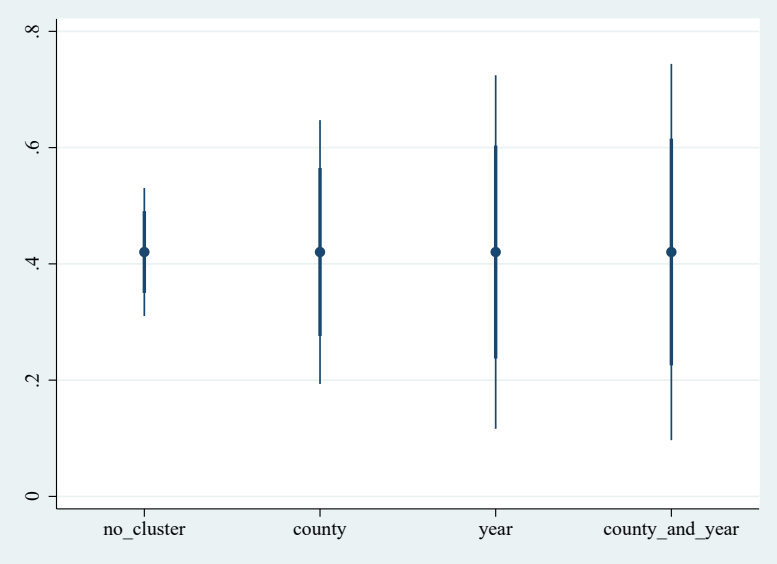

Figure C.1. This figure shows coefficient plots for different clustering strategies for the regression in Table 3, column 2. The point estimates, as well as the 90% and and 99% confidence intervals, are shown for four models: no clustering, county, year, and double-clustered county and year.

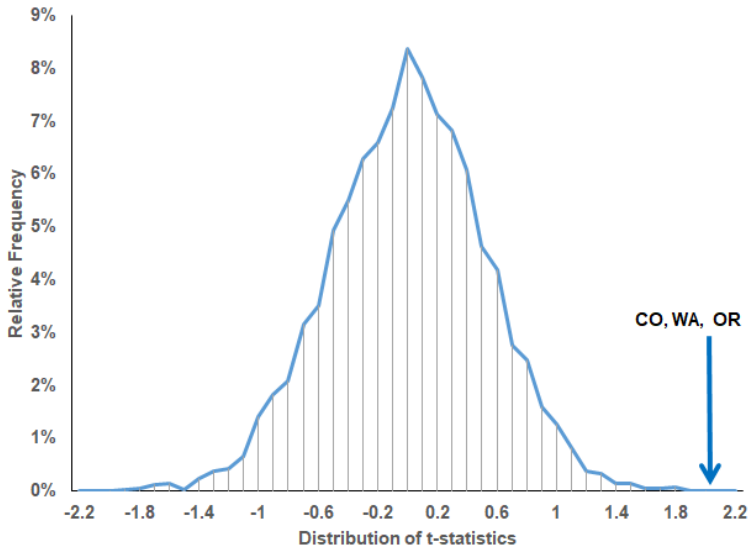

Figure C.2. This figure presents a histogram of a distribution of t-statistics for the slope coefficients of a difference-in-difference specification on loan defaults. I use the specification in Table 3 column 2: $Y_{i,j,\tau} = \lambda_j + \lambda_\tau + \beta_1 D_{j,\tau} + \beta_2 X_{i,j,\tau} + \varepsilon_{i,j,\tau}$, where $Y_{i,\tau}$ is my dependent variable of interest—an indicator of loan default for borrower i; j is the county where the loan originated; and τ is the year the loan originated. The equation includes controls ($X_{i,j,\tau}$) for individual borrower and local labor market characteristics. The specification also includes county (λ_j) and year (λ_τ) fixed effects. $D_{j,\tau}$ represents the indicator for states that (1) legalized recreational marijuana usage and (2) have implemented operational and legally protected dispensaries. For a sample of 10,000 regressions, I randomly substitute three states to coincide with the adoption dates of legalized marijuana.

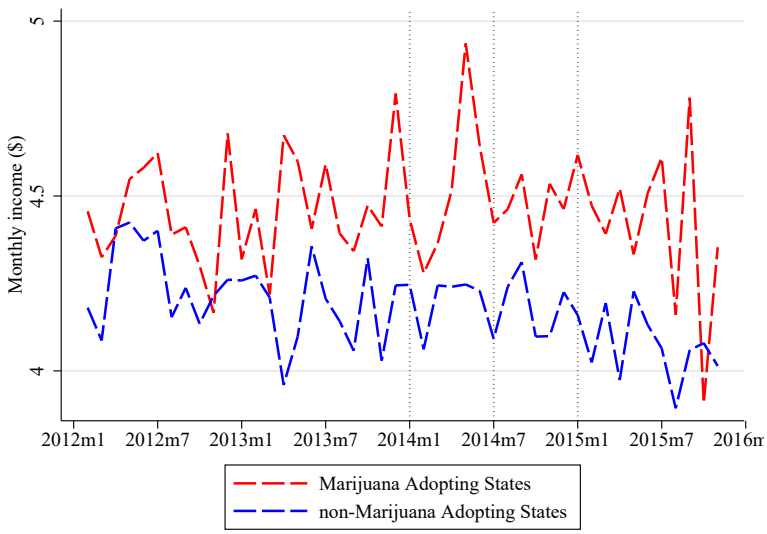

Figure C.3. This figure presents borrower monthly income for each month across states that legalized the sale of marijuana (red) and states that legalized marijuana subsequently (blue). The figure shows dotted lines for the adoption dates of legalized marijuana in Colorado, Washington, and Oregon.

Table C.1

Marijuana Legalization and Opioid Abuse: Collapsed Sample This table reports OLS regressions on the drug-related death rate on an indicator variable (post-legalization) of loans that were terminated in a state that implemented laws allowing the recreational sale of marijuana. This sample, which is collapsed to the county level, includes all states for the years 2012 to 2016 in column 1, but excludes states that had not legalized marijuana sales before 2021 in column 2. Regressions include controls for the riskiness of the borrower (credit score, income, and prior bankruptcy), loan (term, down payment), and vehicle (vehicle book value). State and year fixed effects are included as reported. Robust standard errors, clustered by county, are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep Var:	DRUG_DEATH_RATE	
	1	2
POST_LEGALIZATION	-2.715***	-2.245***
	(0.669)	(0.715)
Borrower Controls	Yes	Yes
Loan Controls	Yes	Yes
Vehicle Controls	Yes	Yes
Year FE	Yes	Yes
State FE	Yes	Yes
Observations	1381	472
Adjusted R^2	0.407	0.320
Sample	All	MJ legal

Table C.2

Balance Test of Treatment and Control Groups. This table reports separate summary statistics for loans underwritten under different marijuana regulatory regimes between 2012 and 2016. The mean, standard deviation, and difference in means are reported for borrower, vehicle, and loan characteristics, as well as loan outcomes. Standard errors for the t-statistics are clustered by state. The treated states are those that legalized recreational marijuana during the sample period; the control states are those that did not legalize recreational marijuana during the sample period but did so later.

	Treated		Control			
	Mean	S.D	Mean	S.D	Difference	t-stat
FICO_SCORE	533.60	48.15	528.80	46.90	4.42	(1.52)
MONTHLY_INCOME	4.45	1.67	4.23	1.54	0.21***	(3.29)
PRIOR_BANKRUPTCY	0.38	0.49	0.31	0.46	0.08	(1.72)
VEHICLE_BOOK_VALUE	13.67	3.85	14.19	3.91	-0.46	(-1.41)
DOWN_PAYMENT	1.02	1.47	0.96	1.32	0.05	(0.91)
TERM	68.59	5.57	68.95	5.62	-0.29	(-1.10)
YIELD_SPREAD	2.28	0.98	2.21	0.90	0.06	(1.35)
ALCOHOL_DEATH_RATE	15.14	4.20	11.35	7.92	3.81	(1.06)
UNEMPLOYMENT_RATE	5.40	1.72	6.32	1.63	-0.86*	(-1.95)
LABOR_FORCE_PARTICIPATION	60.55	3.34	61.22	2.41	-0.68	(-0.34)

Table C.3

Loan Performance and Marijuana Sales. This table reports results from OLS regressions on the drug-related death rate (in columns 1 and 2) and the loan default rate (reported as % in columns 3 and 4). The dependent variable is the quarterly taxable marijuana sales (in millions of dollars) that occurred in each state (0 in states without legal marijuana). The sample includes all states for the years 2012 to 2016 in columns 1 and 3, and excludes states that had not legalized marijuana sales prior to 2021 in columns 2 and 4. Regressions include controls for the riskiness of the borrower (credit score, income, and prior bankruptcy), the loan (term, down payment), the vehicle (vehicle book value), and the macroeconomic environment (unemployment rate, alcohol death rate, labor market participation, and yield spread). State and year fixed effects are included as reported. Robust standard errors, clustered by state-year, are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep Var:	DRUG_DEATH_RATE		DEFAULT	
	1	2	3	4
TAXABLE_MARIJUANA_SALES	-0.009***	-0.006**	-0.023***	-0.032***
	(0.003)	(0.003)	(0.008)	(0.010)
Borrower controls	Yes	Yes	Yes	Yes
Loan controls	Yes	Yes	Yes	Yes
Environment controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Sample	All	MJ legal	All	MJ legal
Observations	50326	20615	59498	24117
Adjusted R^2	0.626	0.633	0.085	0.086