Williams College ECON 379:

Program Evaluation for International Development

Module 8: Impacts of Treatment-on-the-Treated

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photo: Daniella Van Leggelo-Padilla / World Bank

Imperfect Compliance

How High Is Program Take-Up?

Even "free" programs costly for participants, take-up often low

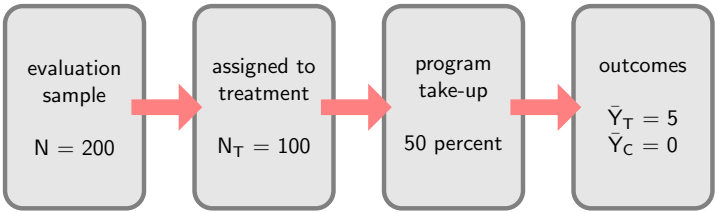
Intervention	**Take-Up**	**Source**
Business training	65%	McKenzie & Woodruff (2013)
Deworming medication	75%	Kremer & Miguel (2007)
Microfinance	13% – 31%	JPAL & IPA (2015)

Only people who do a program can be impacted by the program*

⇒ Might like to know how much program impacted participants (depending on our notion of treatment)

*Some restrictions apply

A Thought Experiment



Questions:

- What was average outcome among those who did the program?
- What does this suggest about the impact of treatment?

Imperfect Compliance

True model when outcomes impacted by program participation (P_i):

$$Y_i = \alpha + \beta P_i + \varepsilon_i$$

- Program take-up is endogenous conditional on treatment
- Only those assigned to treatment ($T_i = 1$) are eligible
- Not everyone participates: $E[P_i|T_i = 1] = \lambda < 1$

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What do we get from standard regression specification:

$$Y_i = \alpha + \beta T_i + \varepsilon_i$$

Imperfect Compliance

Modifying our standard OLS equation, we get:

$$\begin{aligned}\hat{\beta} &= E\left[Y_i | T_i = 1\right] - E\left[Y_i | T_i = 0\right] \\ &= \alpha + \beta E\left[P_i | T_i = 1\right] + \varepsilon_i - \left(\alpha + \beta E\left[P_i | T_i = 0\right] + \varepsilon_i\right) \\ &= \beta E\left[P_i | T_i = 1\right] \\ &= \beta\lambda\end{aligned}$$

where $\lambda < 1$ is the take-up rate in the treatment group

$\Rightarrow$ Low compliance scales down the estimated treatment effect

The Impact of Treatment on the Treated

$$\text{ATE} = \beta\lambda$$

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average treatment effect

(across entire treatment group)

The Impact of Treatment on the Treated

$$\text{ATE} = \beta\lambda$$

impact of treatment

(on those who participate)

The Impact of Treatment on the Treated

$$\text{ATE} = \beta\lambda$$

take-up rate

(among those assigned to treatment)

The Impact of Treatment on the Treated

$$\text{ATE} = \beta\lambda$$

$$\beta = \text{ATE}/\lambda$$

impact of treatment on the treated

Treatment on the Treated: Intuition

The **treatment on the treated (TOT)** estimator:

$$\hat{\beta}_{tot} = \frac{E[Y_i|T_i = 1] - E[Y_i|T_i = 0]}{E[P_i|T_i = 1] - E[P_i|T_i = 0]}$$

TOT scales up ITT effect to reflect imperfect take-up

- Assumption: treatment only works through program take-up
  - Not always obvious whether this is true

Treatment on the Treated: Implementation

Two regressions:

Impact of assignment to treatment on outcome of interest:

$$Y_i = \alpha_2 + \beta_1 T_i + \nu_i \quad \text{[intent-to-treat]}$$

Impact of assignment to treatment on program participation:

$$P_i = \alpha_2 + \beta_2 T_i + \nu_i \quad \text{[first stage]}$$

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Impact of treatment on the treated: $\beta_{tot} = \beta_{itt}/\beta_{fs}$

Treatment on the Treated: Implementation

Estimated via two-stage least squares (2SLS):

$$Y_i = \alpha_1 + \beta_{IV}\hat{P}_i + \varepsilon_i \quad \text{[IV regression]}$$

$$P_i = \alpha_2 + \beta_2 T_i + \nu_i \quad \text{[first stage]}$$

Easy to implement using Stata's `ivregress 2sls` command

- Running two (separate) regressions yields wrong standard error

Treatment on the Treated: Implementation

```
. ivregress 2sls y somecontrol (program=treatment)

Instrumental variables (2SLS) regression          Number of obs   =      1,000
                                                  Wald chi2(2)    =     319.38
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.3221
                                                  Root MSE        =     .95997

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     program |   1.128383   .1214279     9.29   0.000     .8903883    1.366377
 somecontrol |   .9268132    .060714    15.27   0.000      .807816     1.04581
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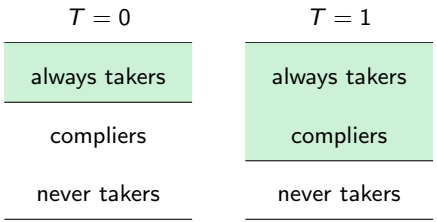
Assumptions Required for IV Estimation of TOT Effect

1. Instrument is exogenous (OK in an RCT)
2. Instrument is correlated with treatment (first stage)
3. Only impacts outcomes through take-up (exclusion restriction)
4. Monotonicity (optional requirement)
   - Not required if treatment effects are homogeneous

What Does Treatment on the Treated Measure?



TOT estimates local average treatment effect (LATE) on **compliers**

- Monotonicity assumption: there are no **defiers**
- We can't estimate impacts on **always takers** and **never takers** because their treatment status doesn't change take-up decision