

Profiling Compliers and Non-compliers for Instrumental Variable Analysis

Moritz Marbach

with Dominik Hangartner

ETH Zurich

Motivation

- ▶ Instrumental variables estimate Local Average Treatment Effect (LATE) for compliers

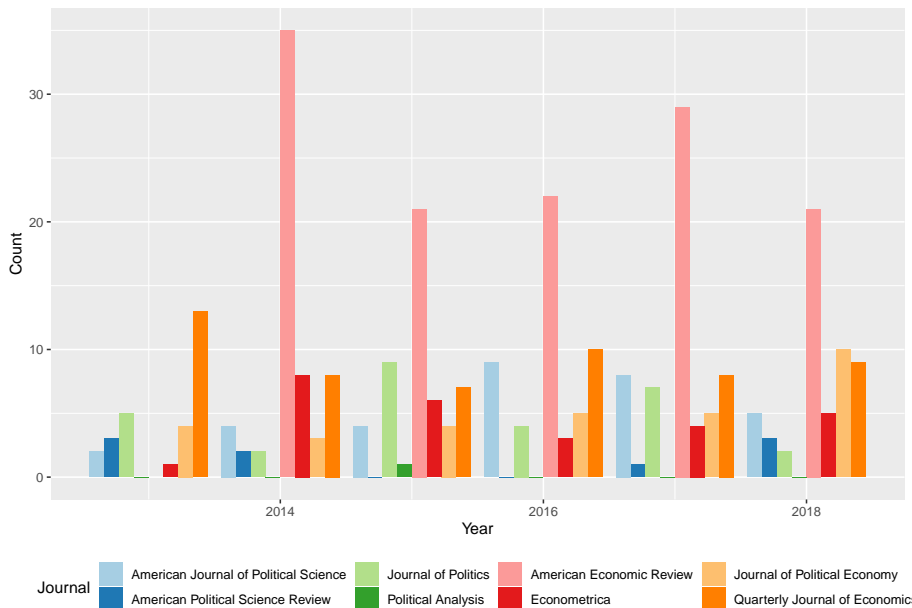
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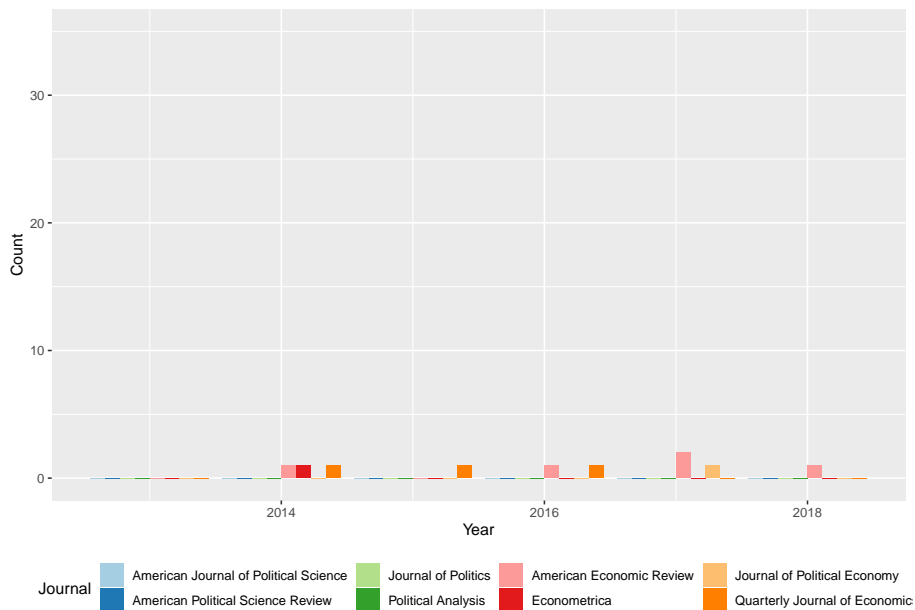
Motivation

- ▶ Instrumental variables estimate Local Average Treatment Effect (LATE) for compliers
- ▶ Compliers: Encouraged by the instrument to (not) take the treatment, these units do (not) take the treatment
- ▶ How different are compliers to non-compliers in terms of covariates?
↪ Generalizability of the LATE

Papers with Instrumental Variables Estimation



Papers with Instrumental Variables Estimation & Profiling



Approaches to Profiling

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 - Statistical inefficient

Setup and Notation

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Definition (Instrument / Assignment to treatment)

Z : Binary instrument, s.t.

$$Z = \begin{cases} 1 & \text{if "encouraged" to receive treatment} \\ 0 & \text{if "encouraged" to receive control} \end{cases}$$

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Assumption

Observed treatment indicator (treatment intake) are realized as

$$D = \begin{cases} D(1) & \text{if } Z = 1 \\ D(0) & \text{if } Z = 0 \end{cases}$$

where $D(Z)$ is said to be the potential treatment.

Compliance Types

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Definition (Compliance Type / Principal Strata)

- ▶ *Complier* (co): takes treatment if encouraged
- ▶ *Defier* (df): 'does the opposite'
- ▶ *Always-taker* (at): always takes treatment
- ▶ *Never-taker* (nt): never takes treatment

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Type/Strata	Instrument and potential treatments
Compliers	$D(0) = 0$ and $D(1) = 1$, i.e. $D(1) > D(0)$
Always-takers	$D(0) = 1$ and $D(1) = 1$
Never-takers	$D(0) = 0$ and $D(1) = 0$
Defiers	$D(0) = 1$ and $D(1) = 0$, i.e. $D(1) < D(0)$

Estimands

Definition (Estimands)

- ▶ $\mu_{co} = E[X|D(0) = 0, D(1) = 1]$
- ▶ $\mu_{at} = E[X|D(0) = 1, D(1) = 1]$
- ▶ $\mu_{nt} = E[X|D(0) = 0, D(1) = 0]$
- ▶ $\mu = E[X]$

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- ▶ Independent of the instrument \rightarrow observed and unobserved never-takers/always-takers are identical (e.g., simple randomization in an experiment)

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- \rightsquigarrow Exclusion restriction not necessary

Intuition of Our Profiling Approach

	Z=0	Z=1
D=0		
D=1		

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D=0	complier never-takers	defiers never-takers
D=1	defiers always-takers	complier always-takers

Intuition of Our Profiling Approach

$$\mu = \pi_{at}\mu_{at} + \pi_{nt}\mu_{nt} + \pi_{co}\mu_{co} + \pi_{df}\mu_{df}$$

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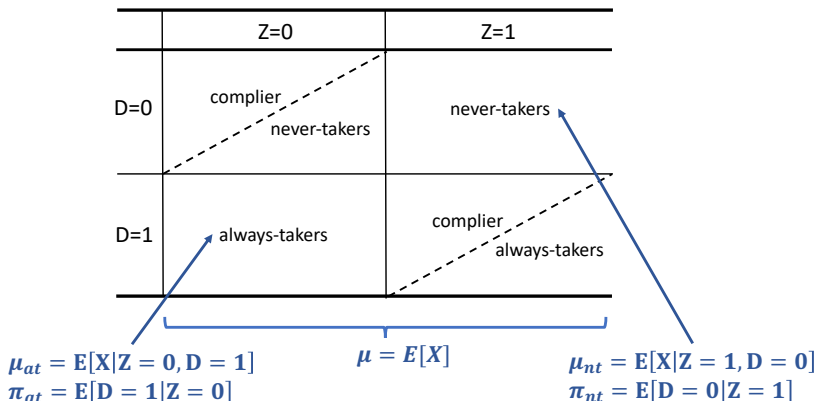
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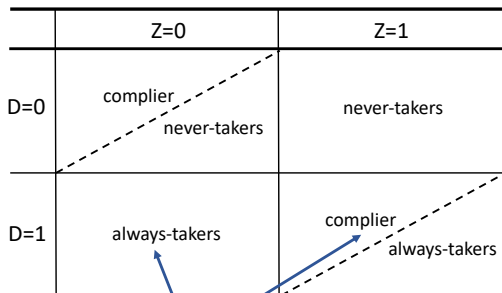
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$$\mu_{co} = (\mu - \pi_{at}\mu_{at} + \pi_{nt}\mu_{nt}) / \pi_{co}$$

Intuition of Our Profiling Approach

$$\mu = \pi_{at}\mu_{at} + \pi_{nt}\mu_{nt} + \pi_{co}\mu_{co}$$



$$\pi_{co} = E[D|Z = 1] - E[D|Z = 0]$$

Our Estimator

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- ▶ Bootstrap to obtain standard errors / confidence intervals


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- ▶ Use sample analogs to obtain estimator
- ▶ Bootstrap to obtain standard errors / confidence intervals
- ▶ Monte Carlo simulations to validate coverage rate and consistency

Example: Proposition 209 Experiment

(Albertson and Lawrence 2009)

**RESIST
209**



**STUDENTS HAVE CALLED
A MEETING
WITH CHANCELLOR TIEN**

**3-5pm Friday Nov. 15
Wheeler Auditorium**

**TOWN HALL MEETING
REGARDING PROP. 209**



Proposition 209 Experiment: Setup and Findings

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		No	Yes
Watched	No	237	142
	Yes	11	117

- ▶ LATE Results: i) No effect on vote choice

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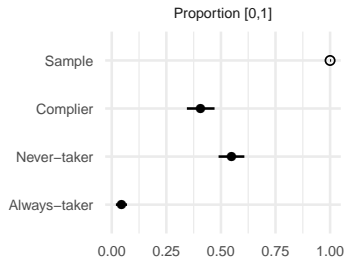
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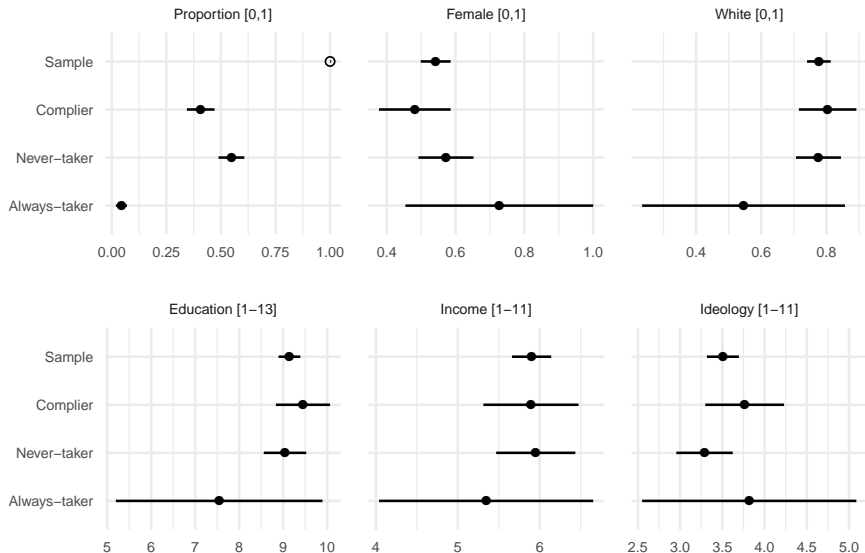
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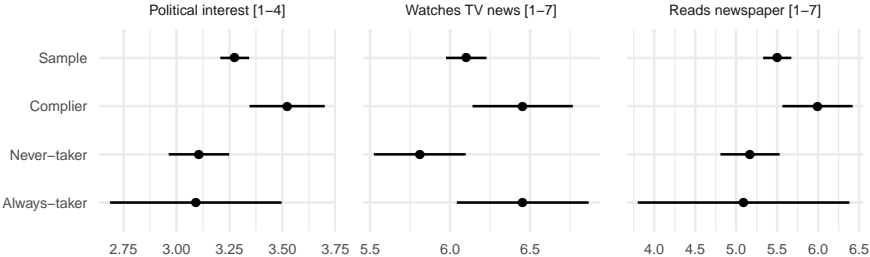
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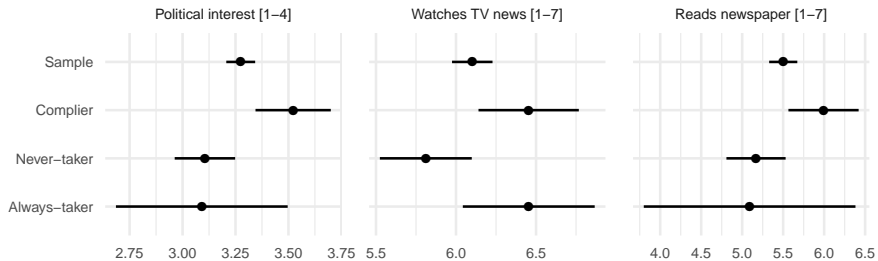
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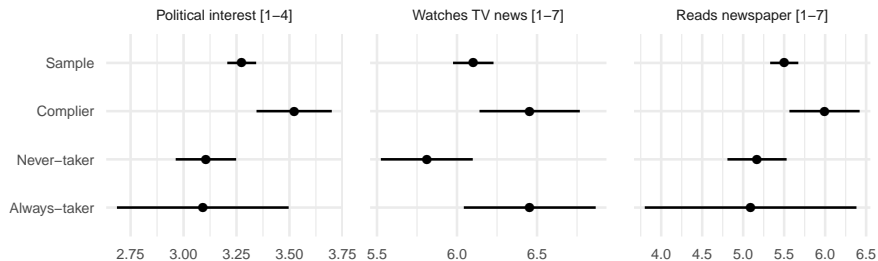


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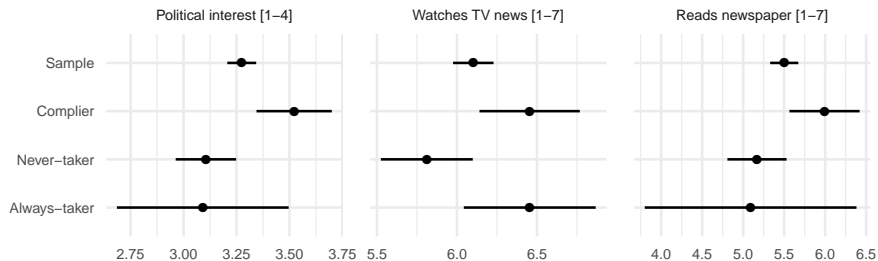
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Informed speculation:

e.g.: Stronger instrument (\$3) → encourages marginal never-takers (e.g., less political interested respondents) → larger effect on self-assessed knowledge → larger LATE

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⇒ Little reason to assume that the LATE generalizes to all participants

Example: Media Experiment

(Gerber, Karlan and Bergan 2009)

The Washington Post

Washington Post | Current | Philadelphia, PA | 4/11/11 | WASHINGTON, APR. 11, 2011 | washingtonpost.com | A4-12

Wishes can come true, despite cap at Pentagon

Controversial 'primitives' got most projects such as 'Gowder' just another chance

BY CHRISTOPHER BOURQUE

It wasn't looking good for the dinosaurs. The budget was tight and the studio was under a lot of pressure. But the movie's path for success was not all that bleak, as the studio's marketing department had a plan. It was to use the power of wishful thinking.

Wizards finish off Bulls to advance



The celebration starts for John Wall as he leads Wizards of Wizards' 10-6 win over the Bulls in Game 5 of their first-round playoff series in Chicago. Washington advanced to second round for the first time since 1993. (AP/WIDE WORLD)

Sterling banned for life after offensive remarks

Commissioner also fines NBA owner \$2.5 million and orders fines paid

BY RICK KATZ

LOS ANGELES — National Basketball Association Commissioner David Stern has banned Los Angeles Clippers owner Steve Ballmer for life and fined him \$2.5 million for making a racist remark on the radio during a game.

Legals, move to Italy a former NFL, but side in more complicated matter

BY DAVID A. THOMAS

The commission handed down its decision on Monday, but has no intention to file charges with state prosecutors.

The Clippers owner has a history of making offensive, legal, right against his former coach, Jerry Tarkanian, on the radio. But he had to make a pledge to cooperate or else the league's commissioner had to take the job.

The NBA owner is expected to be fined \$2.5 million, but will not be fined more for the remark, which is not the first time he has been fined.

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Va. AG rules on 'dreamer' tuition

ASSEMBLY BELIEVED TO ENACT BILLS Some illegal immigrants will now qualify for in-state rates

BY LARRY KOSIOLSKI

Virginia Attorney General Mark R. Herring announced today that he will rule on the national spotlight Tuesday by announcing that some illegal immigrants who were brought to this country as children may now qualify for in-state tuition.

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At Ohio State, hoping to usher in 'the bionic age'

Researchers build computer bridge around paralyzed man's broken spinal cord to restore use of his hands

BY JIM TAYLOR

COLUMBUS, Ohio — Just hours after being struck in the back by a truck, a young man was lying in a hospital bed, his hands and feet in casts and his body in pain. He was paralyzed from the waist down, and his hands and feet were numb. He was told that he would never walk again.

But he was not. He was told that he would never walk again. He was told that he would never walk again. He was told that he would never walk again.

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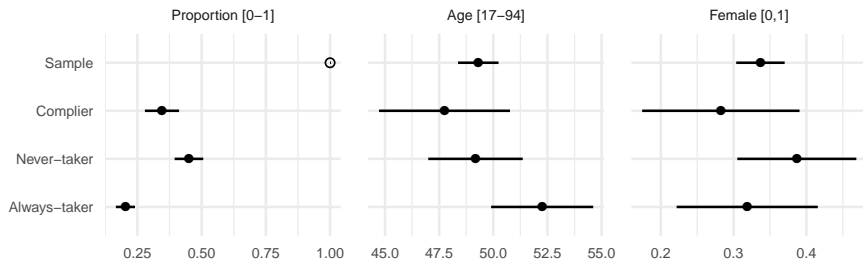
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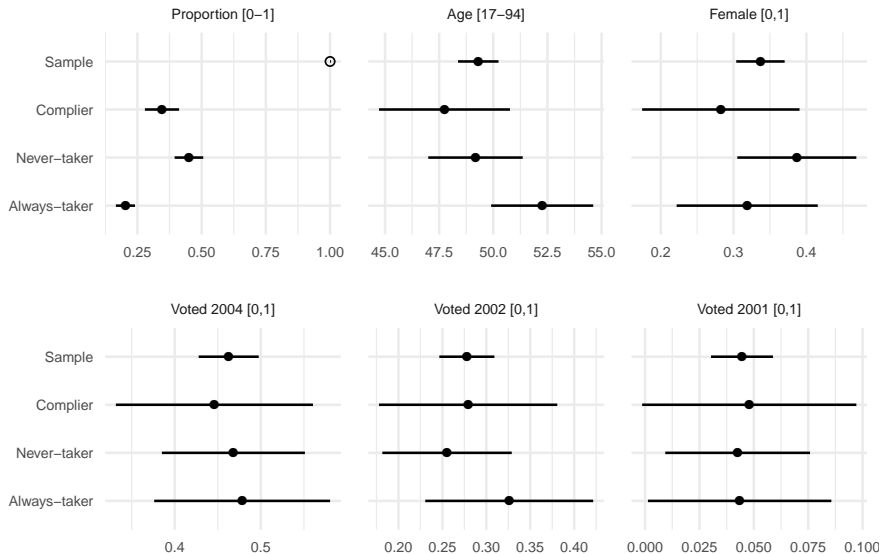
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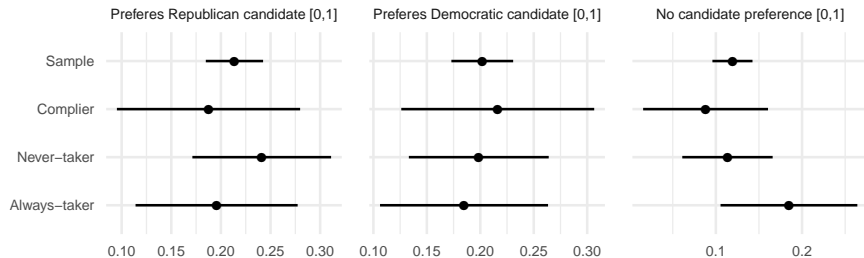
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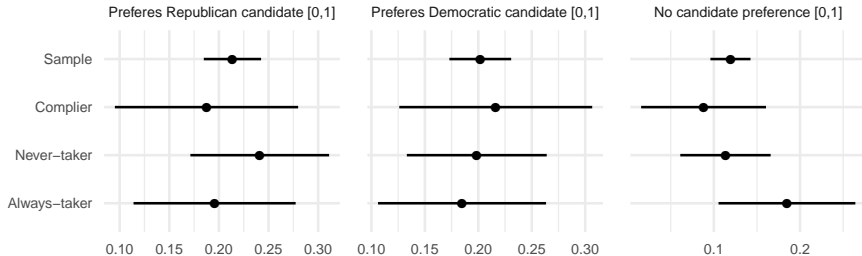
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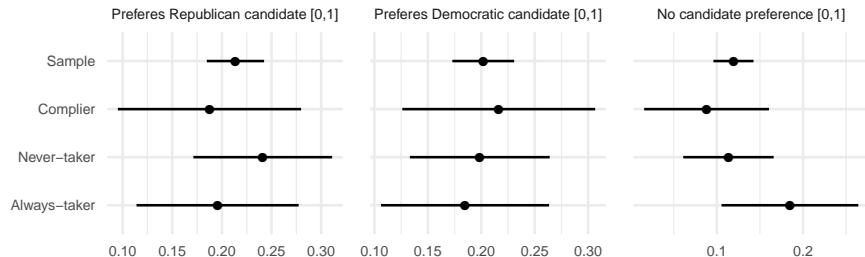


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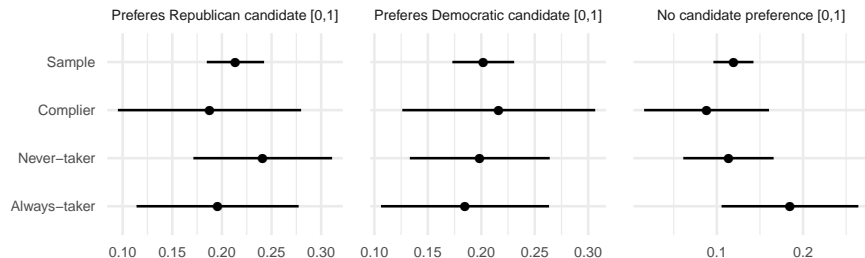
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ivdesc in STATA and R

```
. ivdesc readnews watchpro conditn
```

Variable: readnews

	Mean	Boot.-SE	Proportion	Boot.-SE
whole sample	5.50099	.0910564	1	0
complier	5.992418	.2231848	.4073826	.0328085
never-taker	5.090909	.6581356	.0443548	.0130983
always-taker	5.169014	.1952599	.5482625	.0304623

```
> with(FoxDebate, ivdesc(readnews, watchpro, conditn))
  group      mu      mu_se      pi      pi_se
1 sample 5.500990 0.08703412 1.00000000 0.00000000
2   co 5.992418 0.23057887 0.40738261 0.03412932
3   nt 5.169014 0.18630711 0.54826255 0.03103001
4   at 5.090909 0.67293039 0.04435484 0.01361930
```

Generalizations/Extensions

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- ▶ Continuous IV/treatment \rightsquigarrow Dichotomize (?)

Generalizations/Extensions

- ▶ Observational IV \rightsquigarrow Balance testing w.r.t. IV
- ▶ Continuous IV/treatment \rightsquigarrow Dichotomize (?)
- ▶ Analytical standard errors (coming soon)

Thanks!



github.com/sumtxt/ivdesc
(or via CRAN)



ssrn.com/abstract=3380247