How to use Instrumental Variables

Questions that can be answered with experiments:

1. f g peop e sp r n h h ppens o he r ody e per re

2. f se fer zer on o o p n s do ge ore o oes

O her cond ons co d ffec o co e ho roo for ody e per re r nf for p n s

f h he po er o ho d o her cond ons f ed do so
f c n con ro o her cond ons
r ndo ze re en so h re en s ncorre ed h o her ch nges n cond ons

Questions that can't be answered with experiments:

1. h o d h ppen o q n y de nded f r se pr ce
e o her de er n n s of de nd he s e Pr ce e s c y of de nd
Foo h pr ce see effec on q n y de nded ***P → Q***

2. h o d h ppen o re GDP f r se re n eres r e
e o her de er n n s of re GDP he s e ope of c r e
Foo h re n eres r e see effec on re GDP ***r → Y***

How you *can't* answer nonexperimental questions:

co ec d here r es of n eres r gg e
cross e e ser es
n s cross sec on
e n s p ne
nd o ser e co o e en s e een r es

ec se o her de er n n s re e n cond ons e corre ed h re en

Any h ng h ch nges one econo c r e ch nges o hers oo gener eq r

Re erse c s y

n q n y de nded re en s ΔP

o her r es h ffec Q^D perh ps corre ed h P o her P s

s pp y Q P

n c r e re en s Δr

o her r es h ffec Y perh ps corre ed h r G Y e *por s* Y^e

y or r e $r = r + \alpha\ Y - Y + \beta\ \pi - \pi^*$

How to approach nonexperimental questions

1. gnore reverse c s y nd corre on h o her de er n n s
   - o d p pers
   - econo e r cs f e d here go s o de ons r e echn q e no ns er q es ons

2. Ans er q es on for ode no re or d
   - n ode yo c n e ogeno s y r gg e r e of n eres
   - To q n fy p r e ers ss e ode s r e nd f red ced for s o d

N r e per en s

- F nd so e r gg es n re en r e h re ncorre ed h o her de er n n s
- Of en no es ns r en r e
  - so e h ng e s re e h c ses or nd c es r gg es n re en r e re e n ncorre ed h o her de er n n s d

e g n q n y de nded r e h ffec s s pp y no de nd

- n c r e e ogeno s r ons n cen r n se ng of *r*

In terms of regressions

$Y = \beta_1 X_1 + \beta_2 X_2 + \varepsilon \qquad \varepsilon = \beta X +$

X_1 Pro eso e r e X_2 Con ro r e X n e s r e de er n n s

Gener eq r pro e s $X = \alpha X + \qquad X = \alpha X + \qquad X = \alpha X +$
$X = \alpha X +$

Re erse c s y

$$X = \alpha_Y Y + \alpha X + \quad \rightarrow \quad X = \alpha_Y (\beta X + \beta_2 X_2 + \varepsilon) + \alpha X +$$
corre on h ε

ns r en r es Z

Re en Z s corre ed h X
$X = \gamma_Z Z + \gamma_Z Z_2 +$

d Z s *ncorre ed* h ε no c se or effec or co on c se or

$X = Z + Z_2 +$ E c s on res r c on

How do you find instruments?
How do you know if possible instruments are *relevant* and *valid*?

1. Th n o hy *X* r es L s poss e re sons

2. Th n o o her de er n n s of *Y* L s poss e *X* s

h ch re sons for r on re nre ed o nd *e s r e*

Statistical methods to test whether candidate *Z*'s are relevant, strong & valid

Loo f rs s ge regress on

Chec s gn s gn f c nce gn de p s e of coeff c en on *Z*
Bec se of e ns r en pro e s s or *F* s s for p e *Z* s
need o e *o s gger h n* R e of h e s

Loo red ced for regress on of *Y* on *Z*

$$Y = \beta\left(\gamma_Z Z + \gamma_Z Z_2 + \right) + \beta_2 X_2 + \varepsilon$$

gn gn des of coeff c en s sho d e cons s en h s ory

f yo h e ore h n one *Z* *X* s o er den f ed yo c n es one *Z* g ns o hers
see f res s re cons s en cross *Z* s

d y e c s on res r c on e ns *Z s ncorre ed* h $Y - \beta X - \beta_2 X_2$

Ge es es β β_2
C c e $Y - \beta X - \beta_2 X_2$
c Are *Z s* s ncorre ed h $Y - \beta X - \beta_2 X_2$

rg n es for L nsen es for GMM

Z s re O f yo f o re ec hypo hes s

Are lagged *Y*

Are lagged *Y*'s and/or *X*'s valid instruments? con

Example: supply and demand

You can estimate demand by

$Q^D = -P + \varepsilon$, where $\varepsilon = \rho_D \varepsilon_{-1} + \varepsilon^{new}$, $\rho_D \geq$

$Q = cP + e$, where $e = \rho e_{-1} + e^{new}$, $\rho \geq$

$\beta = -$ $\alpha_Y = c$

so $P = \frac{1}{+c}\varepsilon - e$ $Q = \frac{}{+c}\varepsilon + e$

For P_{-1} or Q_{-1} one of the instruments for P

ρ_D and/or ρ is greater than zero

If $\rho_D \neq$ they are not good because they are correlated with ε

Bottom line for you

n e ery e p r c ny h ng

Try o e e hy X r es cross o ser ons h n yo r s p e

2 Choose one fro e o

do no o effec s s n de nd e s c y c r e s ope

rg e h os r on n X s ncorre ed h n e s r e de er n n s of Y r e

c se B f ed ode

d se ns r en s

f yo choose d

Te e h c ses Z s o ry hy hey re corre ed h X hy hey re d

ho f rs s ge nd red ced for regress ons

Pro e Z s re no *e* h r e of h F es s or R^2 s or o her es s

n ess yo c n e ery s rong *pr or* c se for d y sho rg n or es