

Lecture 9

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Potential Outcome Model

- Try to replicate experimental data.
- Social Experiment: controlled experiment.
 - Caveat: usually very expensive.
- Natural Experiment: observe some exogenous change.
- Fundamental problem of causal inference:
- X is cause, Y is response.
- Change X - change Y .
- Problem: don't observe Y absent the change.

- Need counterfactual.
- Literature: program evaluation, or treatment effects.
- Idea: y_i is the outcome. Variable D_i is 1 treated, 0 if not.
- Outcomes: y_{1i} if $D_i = 1$, y_{0i} if treatment is 0.
- Effect of treatment on individual: $y_{1i} - y_{0i}$.
- Randomly assign treatments to our group.

$$ATE = E[y|D = 1] - E[y|D = 0]$$

- Random: treatment is uncorrelated with attributes: exogenous.
- Need treatment and control (counterfactual) groups.

Problem: Groups might change over time.

$$y_{ij}^t = \alpha + \alpha_1 D_t + \alpha^1 D^j + \beta D_t^j + \varepsilon_{it}^j, i = 1, \dots, N, t = 0, 1$$

Equation could include covariates.

Pre intervention treated, $y_{i0}^1 = \alpha + \alpha^1 D^1 + \varepsilon_{i0}^1$.

Post intervention, $y_{i1}^1 = \alpha + \alpha_1 + \alpha^1 D^1 + \beta + \varepsilon_{i1}^1$.

Impact on treated: $y_{i1}^1 - y_{i0}^1 = \alpha_1 + \beta + \varepsilon_{i1}^1 - \varepsilon_{i0}^1$.

For untreated: $y_{i0}^0 = \alpha + \varepsilon_{i0}^0$,

$y_{i1}^0 = \alpha + \alpha_1 + \varepsilon_{i1}^0$,

and $y_{i1}^0 - y_{i0}^0 = \alpha_1 + \varepsilon_{i1}^0 - \varepsilon_{i0}^0$.

If we difference the impact on treated minus untreated,

$$(y_{i1}^1 - y_{i0}^1) - (y_{i1}^0 - y_{i0}^0) = \beta + (\varepsilon_{i1}^1 - \varepsilon_{i0}^1) - (\varepsilon_{i1}^0 - \varepsilon_{i0}^0).$$

If the mean of the errors is zero, then an unbiased estimator of β is the differences in differences of the averaged y 's.

Equivalently, we could use OLS. We would do this if we had covariates.

Other Issues

- Matching: if control sample is not similar to treatment, but don't want to assume linearity.
- Instrumental variables: endogenous treatment variable.
- Reweighting: surveys may oversample groups, so need to correct to get population inferences.

Application: Card and Krueger (1994)

- Question: Does a minimum wage increase in low wage market also increase unemployment?
- Finding: It does not.
- Obviously, this paper caused much controversy.

Background: On April 1st, 1992, New Jersey raised minimum wage from 4.25 to 5.05.

Card & Krueger surveyed 410 fast food restaurants in New Jersey and Pennsylvania, before & after the change.

Pennsylvania restaurants: control group.

Why Fast Food?

- Leading employer of low wage workers (25% of all restaurant workers).
- Comply with minimum wage regulations.
- Homogeneous job requirements and products.
- Easy to construct a sample frame.
- Good response rates.

Two waves of survey: Feb-March 1992; Nov-Dec 1992.

Restaurants: Burger King, KFC, Wendy's, Roy Rogers.

Sample Frame: 473 stores. 410 responses in first wave.

Higher response rate in NJ than PA.

Second wave interviews were made for 99.8% of the first wave sample.

Variable of interest: full time employment (number of full time workers plus 0.5 times number of part time).

Possible issue: measurement error in results: $x = x^* + \epsilon$, where x is observed, x^* is truth, and ϵ is iid error.

Leads to biases in results.

Some stores were inadvertently interviewed twice. Calculate the reliability ratio, $\frac{\sigma_{x^*}^2}{\sigma_{x^*}^2 + \sigma_u^2}$, correlation between responses in each interview.

Diffs-in-diffs estimate:

$$(21.03 - 20.44) - (21.17 - 23.33) = 2.76$$

Balanced panel: some stores had data for only wave 1 or wave 2. These were dropped (14 obs from wave 1 and 12 from wave 2).

Balanced panel, plus treating 4 temporarily closed stores as having 0 employment.

Employment at high wage NJ stores decreases about the same amount as employment PA stores.

Since high wage NJ stores were likely to be unaffected by min wage, suggests validity of controls.

Drop in employment is attributed to economic downturn in area.

Also run regression adjusted models, since employment growth may be due to other factors.

$$\Delta E_i = a + \mathbf{b}X_i + cNJ_i + \varepsilon_i$$

$$\Delta E_i = a' + \mathbf{b}'X_i + c'GAP_i + \varepsilon'_i$$

$$\begin{aligned}
 GAP_i &= 0 && \text{PA stores} \\
 &= 0 && \text{NJ stores with } W_{1i} \geq 5.05 \\
 &= \frac{(5.05 - W_{1i})}{5.05} && \text{other NJ stores}
 \end{aligned}$$

GAP allows the impact to differ if store has to raise wage more to reach the minimum.

2 versions of NJ_i model: one with no covariates, on sample where covariates aren't missing; one with chain/company owned dummies.

5 versions of GAP_i version.

- Same 2 as NJ, but with GAP instead of NJ.
- These two are then re-estimated with both NJ and GAP. NJ should not be significant, since it measures the impact on NJ stores with initial wages above the minimum.
- A regression with GAP only, adding regional controls.

Last regression makes GAP insignificant, and smaller.

The authors argue this is due to measurement error, since the drop is similar to the reliability ratio.

Robustness

Re-estimate with dependent variable equal to the proportional change in employment. Smaller, positive and insignificant effects.

Other checks:

- Set temporarily closed stores to 0 employment.
- Exclude managers.
- Reweight part time employees (40% or 60%).
- Exclude stores on NJ shore.
- Exclude stores called more than twice.

- Use WLS in proportional changes model.
- Re run for only two NJ areas (unobserved demand shocks).
- Redefine GAP variable for PA (no spurious correlation between GAP and employment).
- Test first differenced specification.
 - implies $E_i^1 = E_i^0 + a + \dots$
 - if E_i^t is measured with error, then that error will be in the residual. E_i^0 will be endogenous.

Overall result: no change.

Full vs part time workers.

Full time workers may be more productive.

Rise in min wage might lead to firm putting more full time in place of part time.

Observe: full and part time are equally paid. Increase in min wage may attract more full time, leading to increase in full time hiring.

Result: positive for NJ dummy, but not significant for wage gap.

No significant impact on the number of hours open or the number of cash registers open.

Nonwage Offsets

Min wage increase may affect other compensation.

Meal discounts: increase as a result of min wage increase.

Insignificant, but positive increase in time to first pay raise.

Insignificant impact on slope of the wage profile.

Min wage increase does lead to price increases, usually consistent with pass through.

Controlling for region brings this down, though.

Store openings - used data on McDonald's openings from 1986-1991.

Dependent variable: proportional increase in store numbers over this period (cross-section - 51 obs).

Don't find impact of min wage on restaurant openings.

Were the results an anomaly?

CPS data on employment: Teenage employment in NJ fell overall (0.7 percent), but rose relative to other states (2.0). Standard error is 3.2.

Economic explanations of the results.

Competitive model: predicts decrease in employment as a result of min wage hike.

Increase could be caused by local demand shocks, but these would also cause price increases, which were'nt observed in NJ.

Monopsony model could imply increase in wages.

Search models can also have this implication.

Problem: industry prices should have gone down (although there is some evidence for relative price changes).

Wage changes should have most impact on supply constrained stores.

Test using stores that offered recruitment bonuses
- no impact.

Continuing the saga:

Comment by Neumark & Wascher (AER, Vol 90, 2000).

- Study obtains payroll data for sample that should overlap with restaurants in CK survey.
- Finds more variability in survey results than in payroll data.
- Finds opposite conclusion from payroll data.

Reply by Card & Krueger (AER, Vol 90, 2000).

- Study obtains BLS data derived from UI payroll-tax records.
- Differences in sample due to difference in PA sample, which shows rise in employment (BLS data and CK data don't).
- Rise is due to data from one Burger King franchise that provided all PA data for N&W.
- How often average payroll hours were reported matters: more growth is observed for biweekly restaurants, and a higher fraction of PA restaurants used biweekly reporting. Need to adjust for this.