Difference in difference

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2018

A simple example

Effect of a new garbage incinerator on housing values

- Kiel and McClain (1995)

  1978 Rumor that a new incinerator would be built
  1981 Construction, expected to be in operation soon after
  1985 Operation

Hypothesis and data

Hypothesis

The price of houses located near the incinerator would fall relative to the price of more distant houses

- two years of data
  - prices of houses that sold in 1978
  - prices of houses that sold in 1981

Naive analyst

- Use only the 1981 data, estimate a very simple model:

$$rprice = \gamma_0 + \gamma_1 nearinc + u,$$

$$nearinc = \begin{cases} 1 & \text{if the house is near the incinerator (<3mi)} \\ 0 & \text{otherwise} \end{cases}$$

Naive analyst results

- We have:

$$\widehat{rprice} = \underset{(3,093.0)}{101,307.5} - \underset{(5,827.71)}{30,688.27} \, nearinc \quad (1)$$

intercept Average selling price for homes not near the incinerator

coefficient Difference in the average selling price between homes near and not near the incinerator

- What does this mean?
- Do we accept our hypothesis?

Do the same using 1978 data

$$\widehat{rprice} = 82,517.23 - 18,824.37\, nearinc$$
$$\quad\quad\quad\quad (2,653.79) \quad\quad (4,744.59) \quad\quad\quad\quad (2)$$

- Even before there was any talk of an incinerator, the average value of a home near the site was already 18,824.37 less
- Difference is statistically significant
- Incinerator was built in an area with lower housing values

What can we do?

- Look at how the coefficient on *nearinc* changed between 1978 and 1981.

$$\hat{\delta}_1 = -30,688.27 - (-18,824.37) = -11,863.9$$

Thro is the effect of incinerator (handwritten)

- This is our estimate of the effect of the incinerator on values of homes near the incinerator site
- $\hat{\delta}_1$ is known as the difference-in-differences estimator

$$\hat{\delta}_1 = (\overline{rprice}_{81,nr} - \overline{rprice}_{81,fr}) - (\overline{rprice}_{78,nr} - \overline{rprice}_{78,fr}) \quad (3)$$

- $\hat{\delta}_1$ is the difference over time in the average difference of housing prices

Is the difference statistically significant?

- Find the standard error using regression

  only 1978 value

  $$rprice = \beta_0 + \delta_0 y81 + \beta_1 \, nearinc + \delta_1 y81 \cdot nearinc + u \qquad (4)$$

  β_0 average price of a home not near the incinerator in 1978

  δ_0 changes in all housing values from 1978 to 1981

  β_1 location effect that is not due to the incinerator → *1 or 0 depending*

  δ_1 decline in housing values due to the new incinerator *on location*

Effect of incinerator

Effects of incinerator location on housing prices

TABLE 13.2 Effects of Incinerator Location on Housing Prices			
Dependent Variable: *rprice*			
Independent Variable	**(1)**	**(2)**	**(3)**
constant	82,517.23 (2,726.91)	89,116.54 (2,406.05)	13,807.67 (11,166.59)
y81	18,790.29 (4,050.07)	21,321.04 (3,443.63)	13,928.48 (2,798.75)
nearinc	−18,824.37 (4,875.32)	9,397.94 (4,812.22)	3,780.34 (4,453.42)
y81·nearinc	−11,863.90 (7,456.65)	−21,920.27 (6,359.75)	−14,177.93 (4,987.27)
Other controls	No	age, age^2	Full Set
Observations	321	321	321
R-squared	.174	.414	.660

handwritten annotations: DiD estimator; age of house; All variables

Figure: Introductory Econometrics A Modern Approach - Wooldridge (2012)