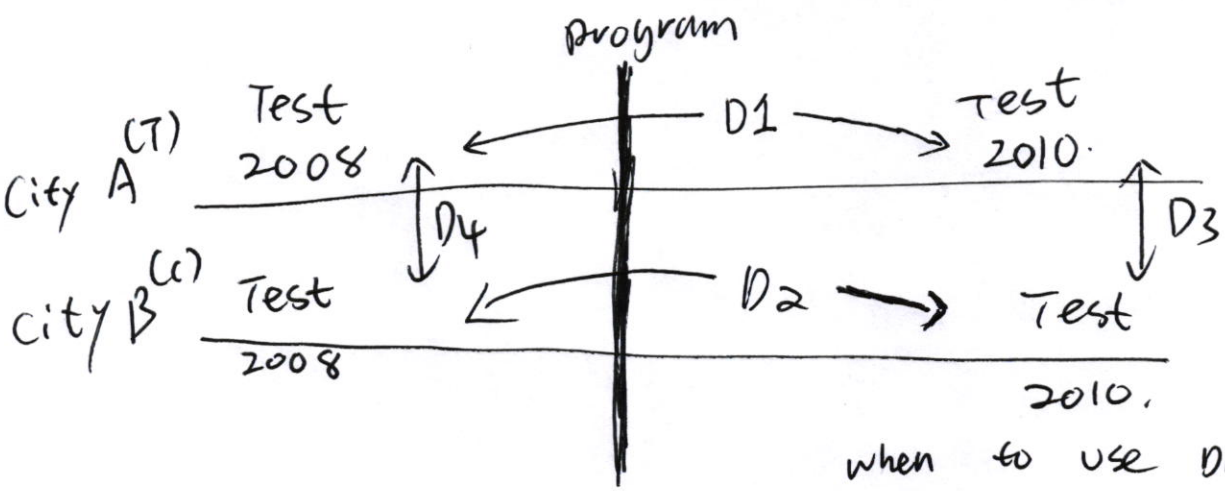
Difference - In - Differences

Motivation: i.e. Do free school lunches improve student outcome?



D_2 is not enough. what if a special event happened in 2008, not 2010?

when to use DiD:

- program/treatment evaluation
- T & C
- Before & after.

$$DD = D_1 - D_2$$
$$DD = D_3 - D_4$$

example.

Y	Pre	post	DD.
Control	$\bar{Y}_{c,pre}$ 30	$\bar{Y}_{c,post}$ 70	-40
Treatment	$\bar{Y}_{Tr,pre}$ 20	$\bar{Y}_{Tr,post}$ 90	-70
DD	10	-20	30

DD with regression

$$y = \beta_0 + \beta_1 D^{post} + \beta_2 D^{Tr} + \beta_3 D^{post} \cdot D^{Tr} + \beta_x X + \varepsilon.$$

X: vectors of controls

How it works?

Y	$D^{post}=0$ (pre)	$D^{post}=1$ (post)	
$D^{Tr}=0$ (control)	β_0	$\beta_0+\beta_1$	β_1
$D^{Tr}=1$ (Treatment)	$\beta_0+\beta_2$	$\beta_0+\beta_1+\beta_2+\beta_3$	$\beta_1+\beta_3$
	$-\beta_2$	$-\beta_2-\beta_3$	β_3 (ATE)

unbaised DiD estimate? (identifying assumption)

- ※ Parallel Trend
  - w/o treatment C and T have parallel trend
  - Treatment effect come from difference in trend.