Difference in Difference Design

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2021

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Structure of this session

1	Understand what is a Difference in Difference Design (DiD)
2	Understand under what conditions should the DiD be implemented
3	Discuss the assumptions
4	Limitations of DiD
5	Examples of DiD
6	References

When do we use DiD?

- It is always not possible to randomize
- E.g: Estimating the impact of a past program

- We need to identify:
  - Which group was affected by the policy change (treatment)
  - Which group was unaffected (control)
  - What was the treatment

- We can try to find a policy that mimics a ‘natural experiment’ to elicit causality
- A policy that affects some groups and not others

Intuition behind DiD

We are interested in changes in outcomes between treated and control groups, to estimate program impact

Example

Estimating the impact of a road construction program

Objective

To improve labour market outcomes, such as employment

Intuition behind DiD

Option 1:

Can we compare Employment in treated areas, before and after?

Intuition behind DiD

Option 2:

Can we compare employment in treated and control areas

Intuition behind DiD

- DiD: It compares the before and after changes in outcomes for the treated group to the before and after changes for the control group

- First Difference: Before and after changes in outcomes for the treatment

❑Controls for factors that are constant over time

- Second difference: Before and after changes in the outcomes of the control

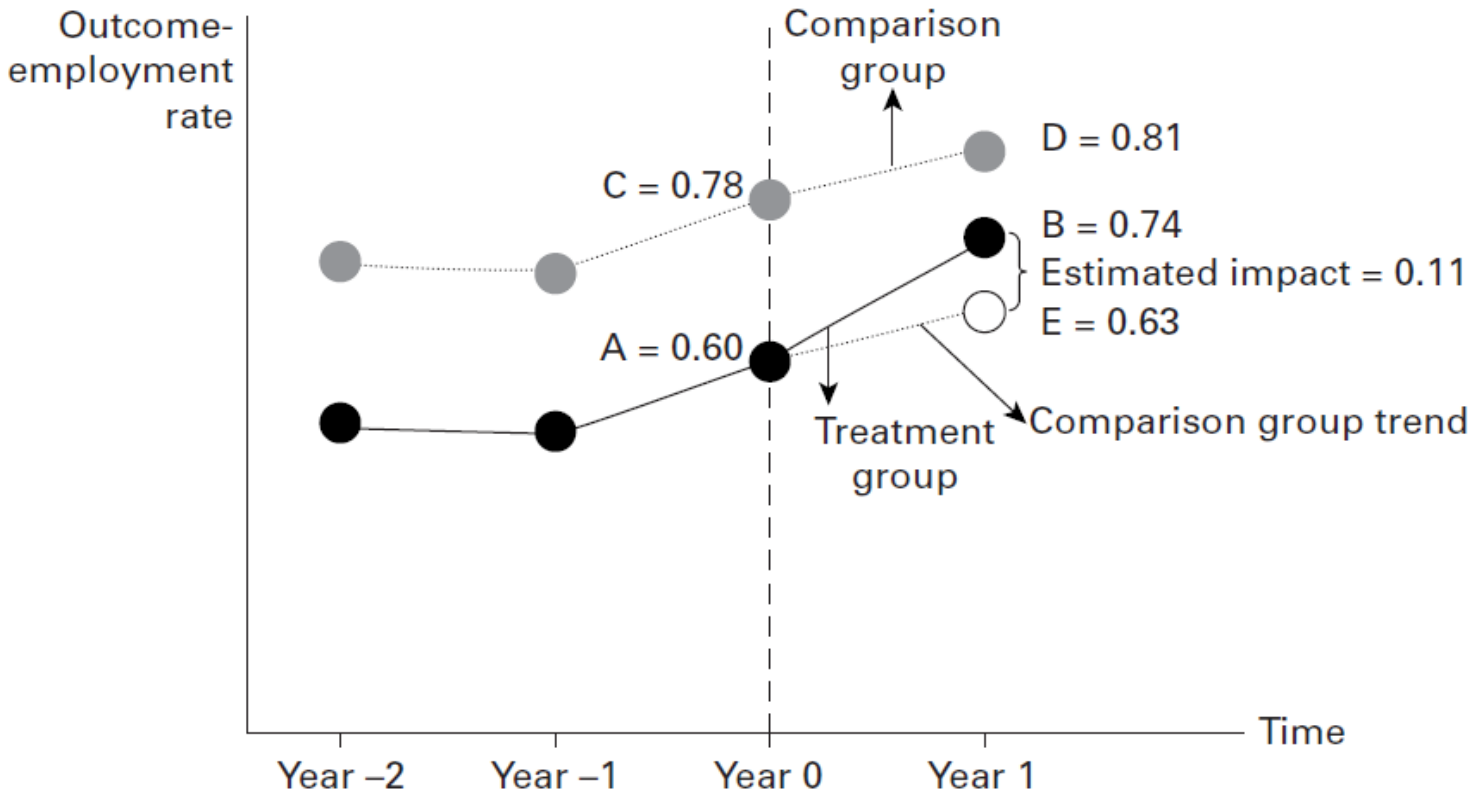
❑Controls for time varying factors

  - Road construction example: Changes in Employment before and after the program in treated areas to changes in employment before and after the program in control areas

Conceptualizing the DiD

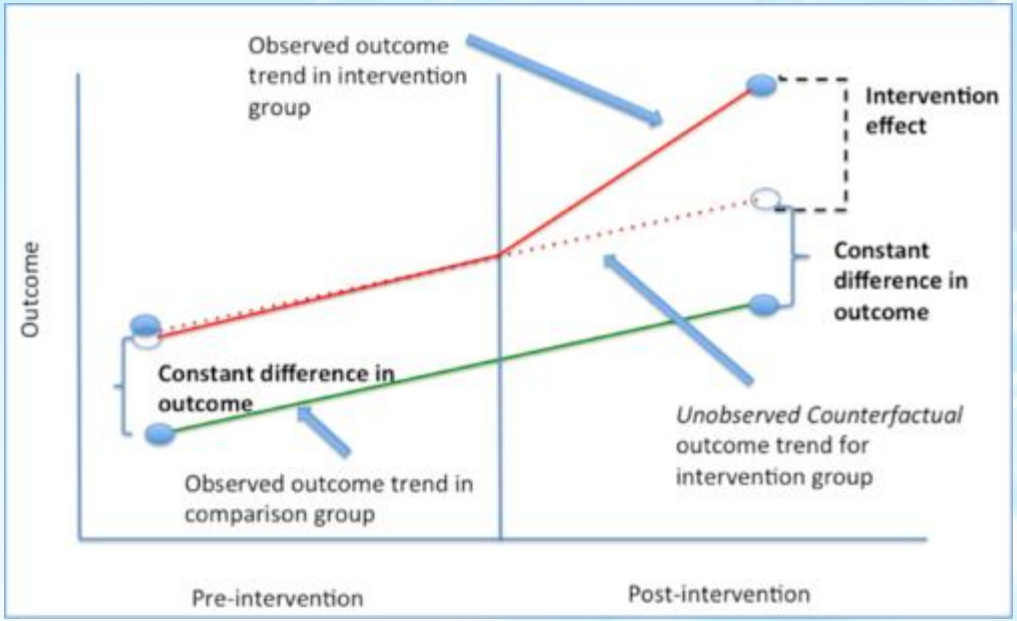
	After	Before	Difference
Treatment/enrolled	B	A	$B - A$
Comparison/nonenrolled	D	C	$D - C$
Difference	$B - D$	$A - C$	DD $= (B - A) - (D - C)$

	After	Before	Difference
Treatment/enrolled	0.74	0.60	*0.14*
Comparison/nonenrolled	0.81	0.78	*0.03*
Difference	*–0.07*	*–0.18*	DD $= 0.14 - 0.03 = 0.11$


Outcome-employment rate
Comparison group
D = 0.81
C = 0.78
B = 0.74
Estimated impact = 0.11
E = 0.63
A = 0.60
Treatment group
Comparison group trend
Time
Year –2
Year –1
Year 0
Year 1

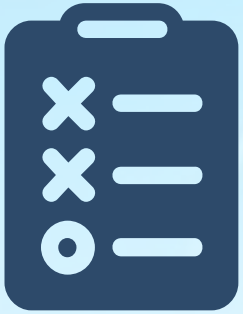
Key assumptions of the DiD

Parallel trend assumption



- In the absence of the policy/program, outcomes need to be in tandem between treated and control areas

Key assumptions of the DiD



Covariate balance test
On average, both observable and unobservable characteristics should not vary between both groups

Placebo test
Using a ‘fake’ treatment group that was not affected by the program

Limitations of DiD

1

- This requires significant data on the outcomes before and after the program for different groups of the population

2

- The difference in outcomes between treatment and control groups due to the program and nothing else.

Example 2

Policy: Evaluating a health insurance subsidy policy

Objective: Does subsidy affect household health expenditures

Data requirements:

- Two rounds of surveys for households
- Both surveys have data on those enrolled into the program (treatment) and those that are not enrolled (control group)

What is the first (and second) difference estimate?

	After (follow-up)	Before (baseline)	Difference
Enrolled	7.84	14.49	−6.65
Nonenrolled	22.30	20.79	1.51
Difference			DD = −6.65 − 1.51 = −8.16

Note: The table presents mean household health expenditures (in dollars) for enrolled and nonenrolled households, before and after the introduction of HISP.

Regression estimation

	Linear regression	Multivariate linear regression
Estimated impact on household health expenditures	–8.16** (0.32)	–8.16** (0.32)

Note: Standard errors are in parentheses. Significance level: ** = 1 percent.

References

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