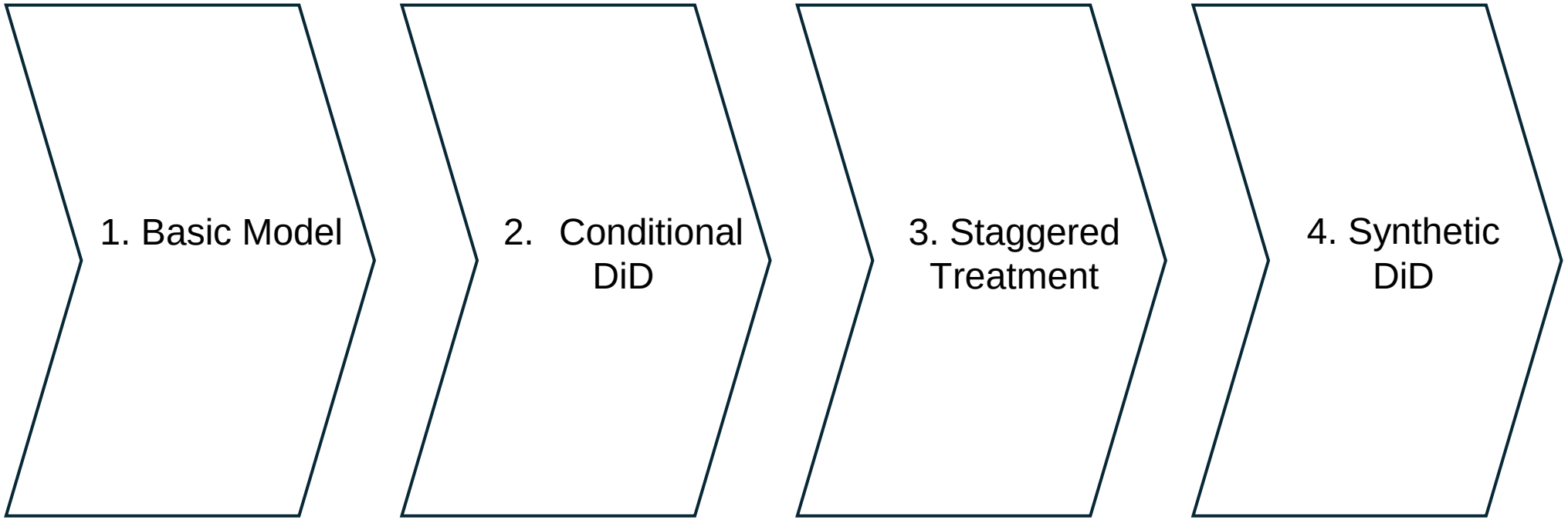
Recent Developments in Difference in Differences Analysis

B520 Research Seminar on Marketing SS2024

B. Herzberger, J. Lympany, T. Matengu

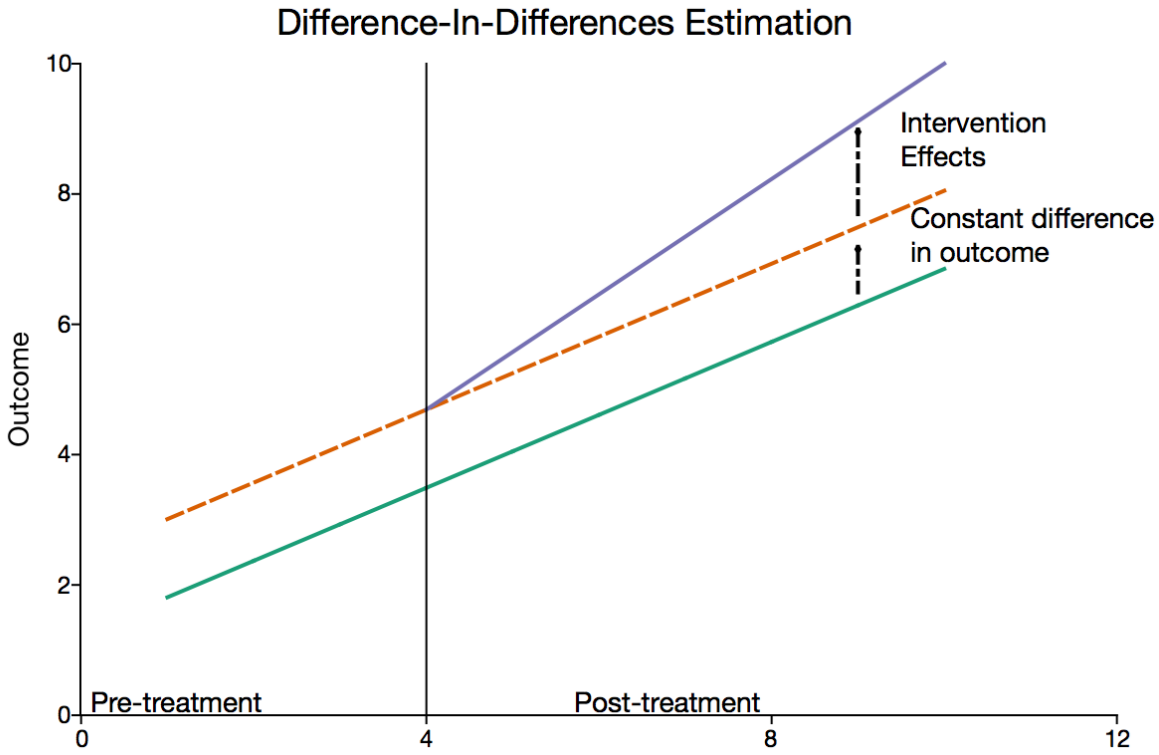
Structure of the Presentation



1. The Basic DiD Model

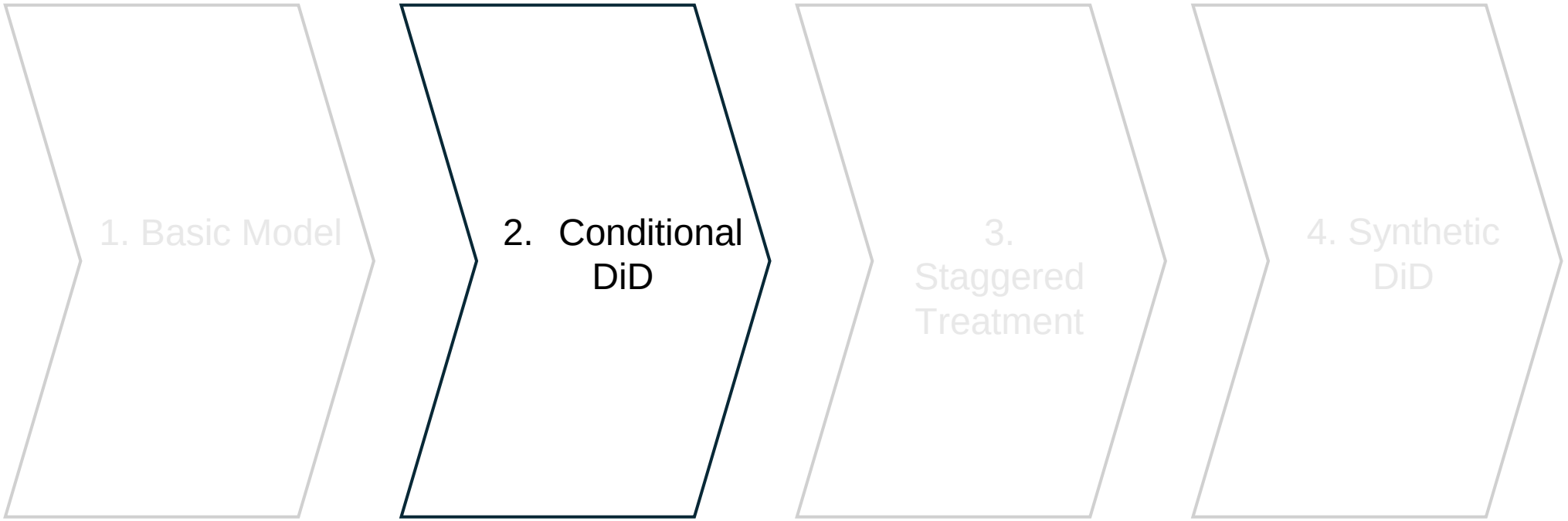
Assumptions

- Parallel trends
- Homogeneous treatment
- No treatment anticipation



source : https://www.aptech.com/blog/introduction-to-difference-in-differences-estimation/

Structure of the Presentation



2. Conditional DiD

Plan

- Rambachan & Roth (2023):
  - A more credible approach to parallel trends
- Sant'Anna & Zhao (2020):
  - Doubly robust difference-in-differences estimators
- Bilinski & Hatfield (2018):
  - Nothing to see here? Non-inferiority approaches to parallel trends and other model assumptions

… parallel trends violations and points to consider …

… conditional DiD and how it can be leveraged …

… accounting for heterogeneous treatment effects …

?

2. Conditional DiD

Data-generating process

- 7 time points 20 units
- Trend over time
- 50 % of units assigned to treatment/control
- external shock for some of the treated units

Input = heterogeneity, violation

- Heterogeneity, 0 -> all effects = 1 (Homogeneity)
- Heterogeneity, not 0 -> varying effects mean = 1
- Violation, 0 -> no violation
- Violation, not 0 -> size of parallel trends violation

Process

y = trend + treat * 0.2 + post * treat * effect + post * external-shock * violation + random-change

2. Conditional DiD

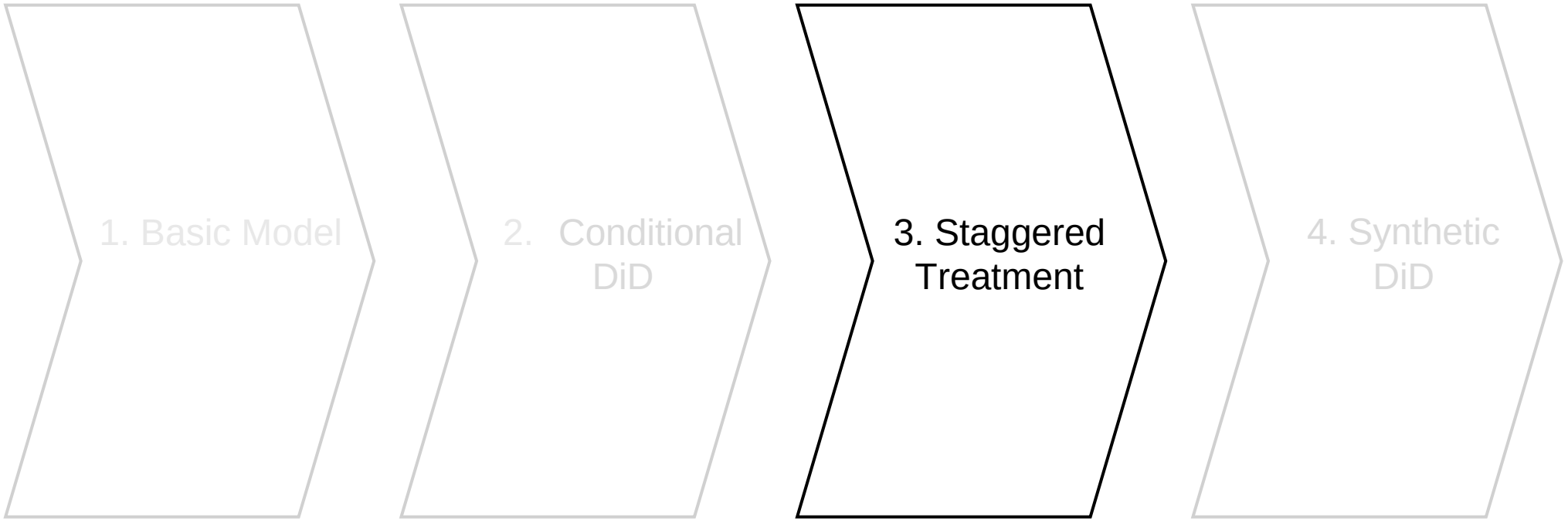
Plan

- Conduct simulations with varying input factors
- Calculate ATTs using ***att_gt*** from Callaway (R) … both standard and conditional ...
- Reveal impacts and biases from varying heterogeneity and violations

Research Hypotheses

1. Does the bias of ATT-estimates under violations of parallel trends decrease when conditioned on?
2. Does heterogeneity in treatment effects increase the bias of the ATT-estimates?

Structure of the Presentation



3. Staggered DiD

Literature

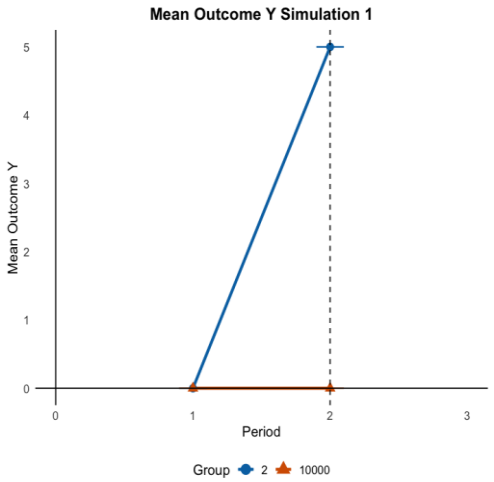
- Goodman-Bacon(2021)
  - Variance-weighted TWFE Regression
- Sun & Abraham (2021)
  - Relative time periods
- Cengiz et al. (2019)
  - Stacked regression

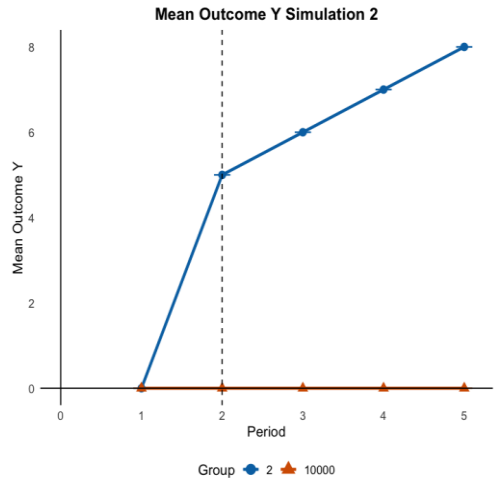
Research Questions

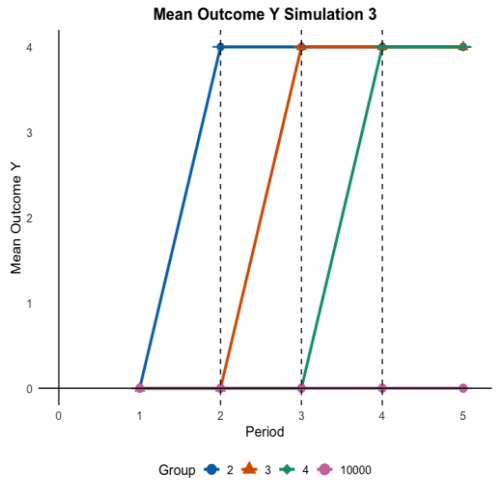
1. What assumptions must hold for a TWFE regression to be accurate?
2. Which alternative estimator works the best under violations of these assumptions

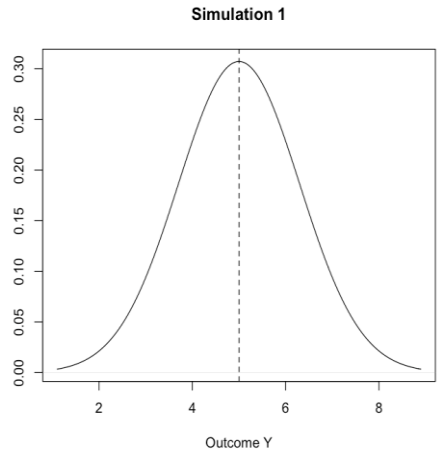
?

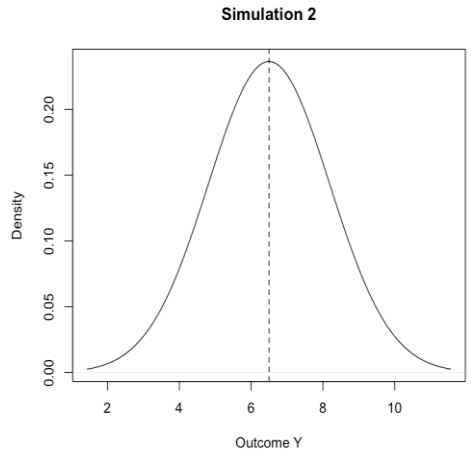
3. Staggered DiD

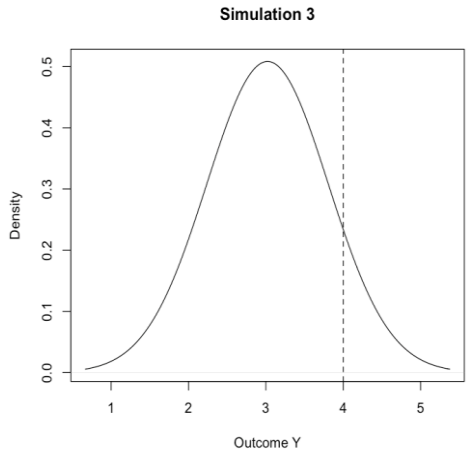




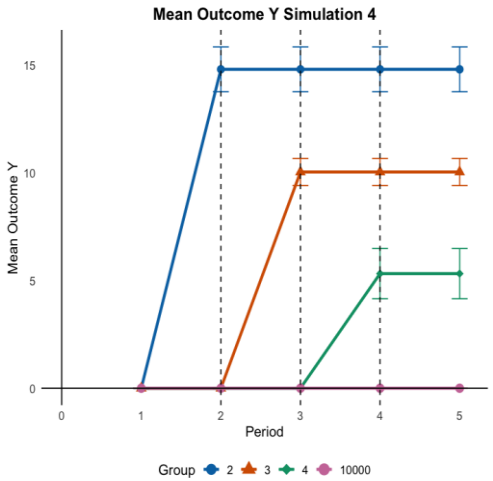


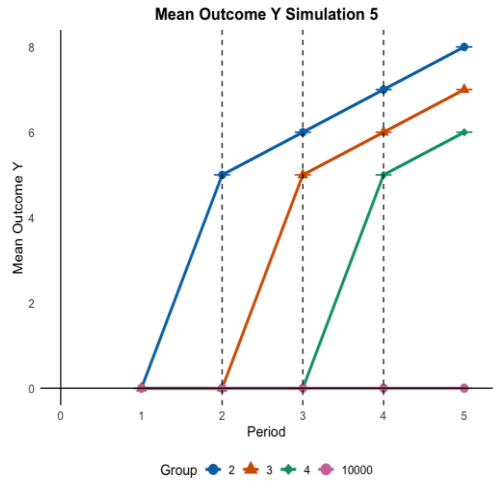


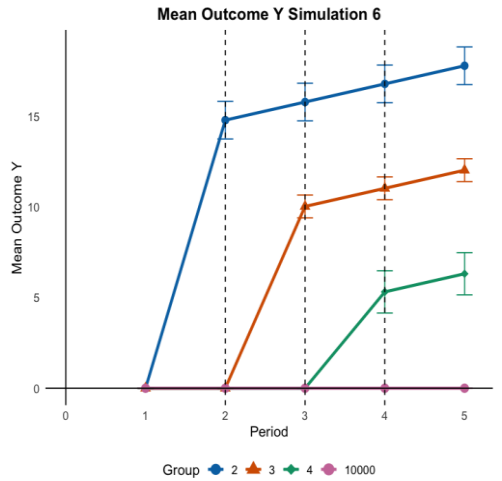


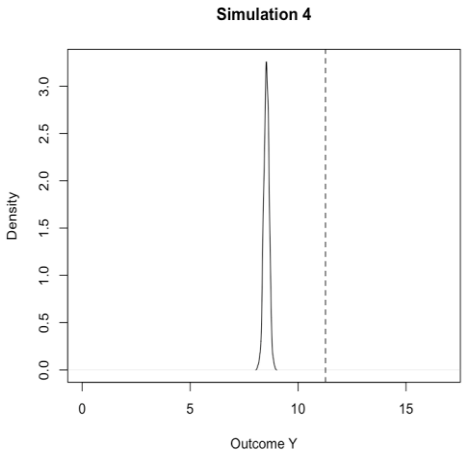


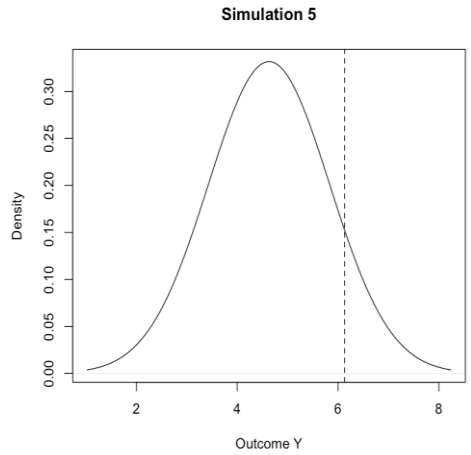
3. Staggered DiD

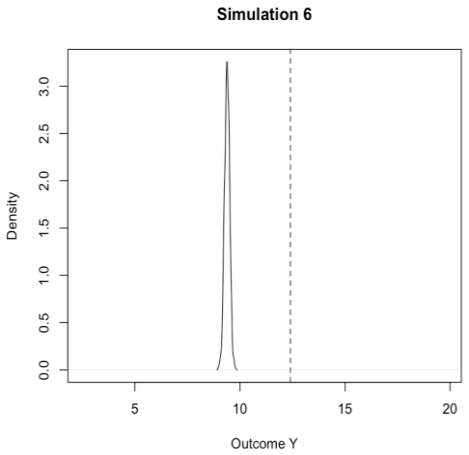




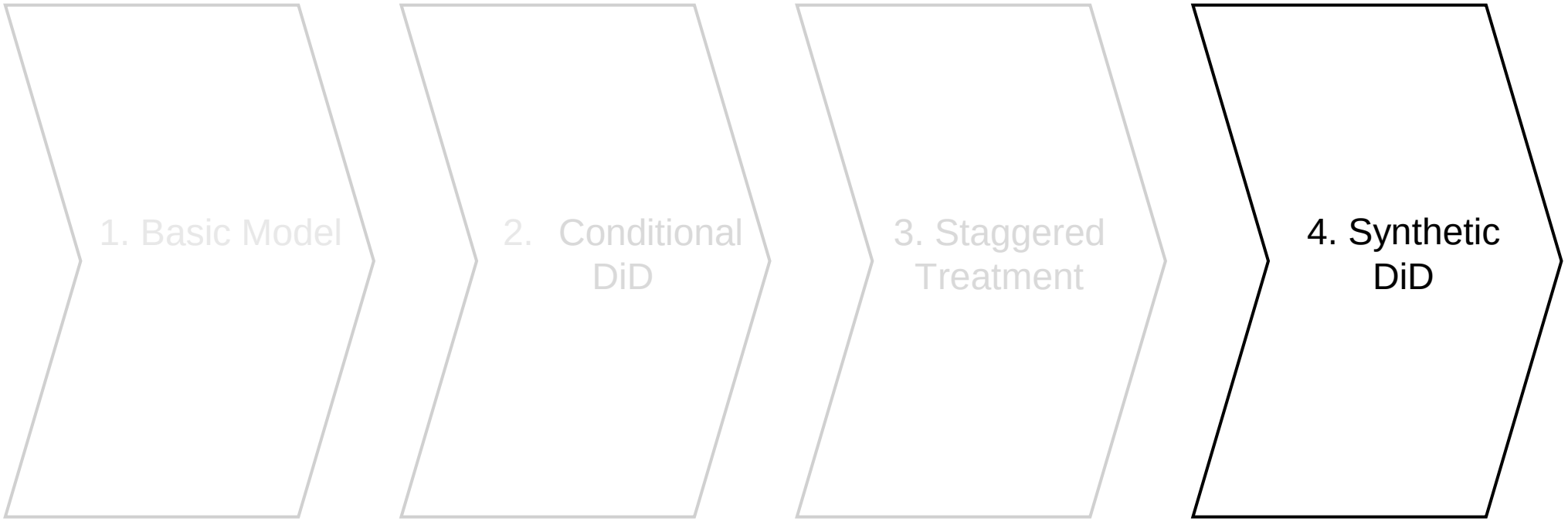








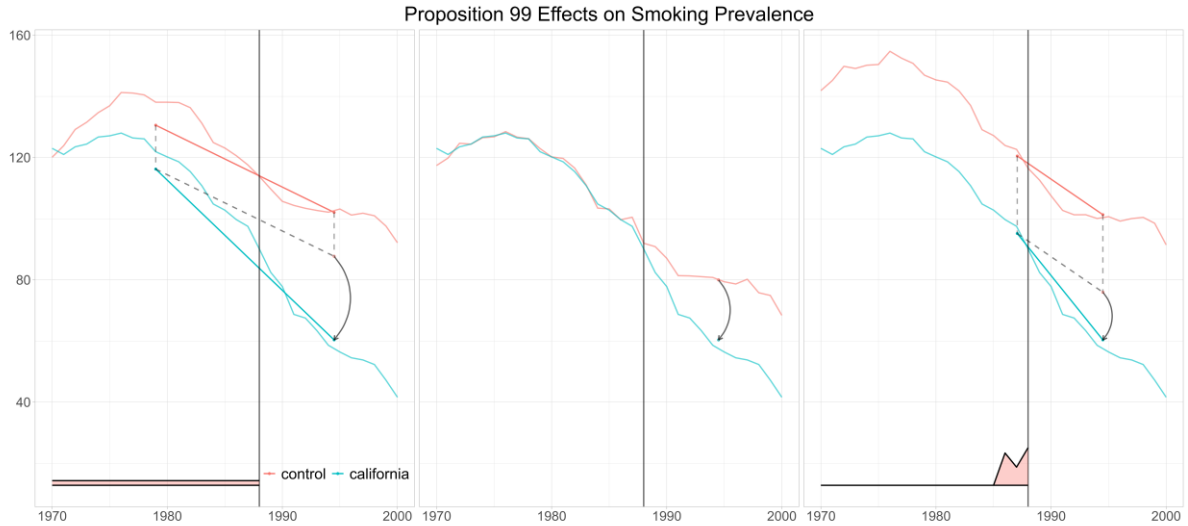
Structure of the Presentation



4. Synthetic Difference in Differences

Approach

- Comparison of Synthetic Difference-in-Differences (SDiD), Synthetic Control (SC) & standard DiD
- Difference to standard DiD
  - Key problem: No counterfactual to use for estimation
  - SC (Abadie et al.): Reweighting of control units to construct an artificial control unit to most closely resemble the treated
  - SDiD (Arkhangelsky et al.): Combines and refines SC and DiD by also incorporating time-trends



4. Synthetic Difference in Differences

Approach

- Data simulations varying in:
  - Sample size
  - Violation of parallel-trends (pre & post)
  - Treatment effect: Size, dynamic vs. static, heterogeneity, period
- Estimation via {synthdid} package (Arkhangelsky et al.)

Research question

1. Under what conditions do the methods produce different/identical results?
2. Under what conditions do the respective methods work better/worse?
3. Is there a “best” method? If not, when to use which approach?

?

4. Synthetic Difference in Differences