FLS 6441 - Methods III: Explanation and Causation

Week 8 - Difference-in-Differences

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Classification of Research Designs

		Independence of Treatment Assignment	**Researcher Controls Treatment Assignment?**
Controlled Experiments	Field Experiments	✓	✓
	Survey and Lab Experiments	✓	✓
Natural Experiments	Natural Experiments	✓	
	Instrumental Variables	✓	
	Discontinuities	✓	
Observational Studies	Difference-in-Differences		
	Controlling for Confounding		
	Matching		
	Comparative Cases and Process Tracing		

Section 1

Difference-in-Differences

Difference-in-Differences

- What if we have *NO* variation in treatment that is independent of potential outcomes?

Difference-in-Differences

- What if we have *NO* variation in treatment that is independent of potential outcomes?
- Then we have an *Observational* study

Difference-in-Differences

- Two types of observational studies:

Difference-in-Differences

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Difference-in-Differences

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Difference-in-Differences

- Two types of observational studies:

1. **Cross-sectional:** Compare outcomes across different units, **treated** and **control**
   - BUT Omitted variable bias
2. **Time-series:** Compare outcomes of units **before** and **after** treatment
   - BUT Outcomes might change over time for reasons other than treatment ('Overall Trend Bias')

Difference-in-Differences

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   - Even *unobserved* fixed characteristics

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Difference-in-Differences

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Difference-in-Differences

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- Comparing **across units** and **across time**
- Comparing **changes** instead of **levels**
- Removing the risks from both overall trends and omitted variables

Difference-in-Differences

	Balances time-invariant 'fixed' unit characteristics		**Balances time-varying characteristics**	
	Observed	Unobserved	Overall trends	Unit-specific trends
Field Experiments	✓	✓	✓	✓
Survey and Lab Experiments	✓	✓	✓	✓
Natural Experiments	✓	✓	✓	✓
Instrumental Variables	✓	✓	✓	✓
Regression Discontinuity	✓	✓	✓	✓
Cross-sectional comparisons	X	X	✓	X
Before-After comparisons	✓	✓	X	X
Difference-in-Differences	✓	✓	✓	X

Difference-in-Differences

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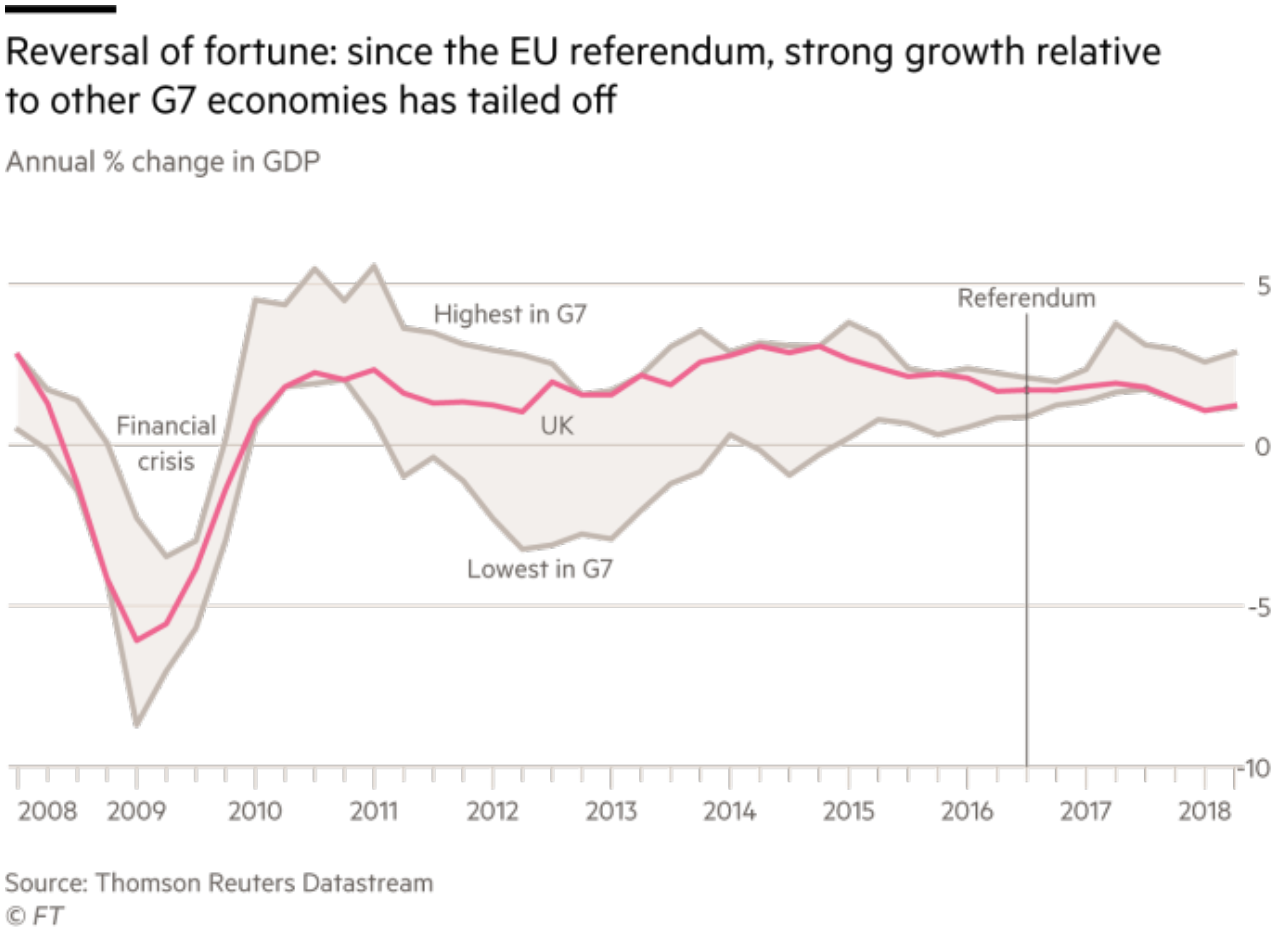
  - Comparing with European growth rates is biased - UK growth is influenced by oil, different labour laws etc.
  - Comparing before and after the Brexit vote is biased - the world economy improved around the same time as Brexit (coincidentally)
  - But compare how European growth **changed** (+0.3%) and UK growth **changed** (-0.4%)
  - The net effect of Brexit is -0.7%

Difference-in-Differences



Difference-in-Differences

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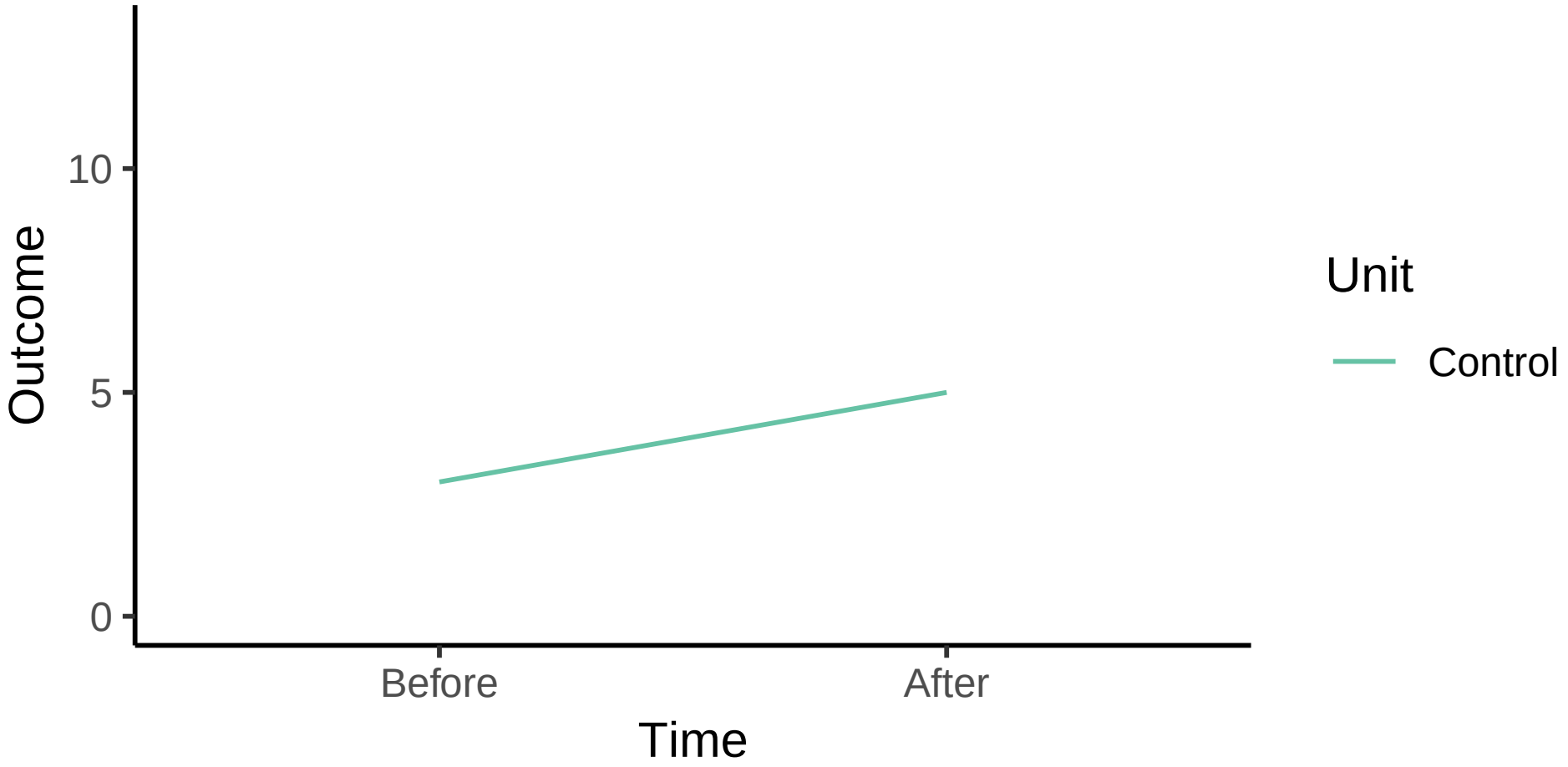
2. Maybe the UK passed other policies at the same time as Brexit?
   - We have to check there are no **compound treatments**

Difference-in-Differences



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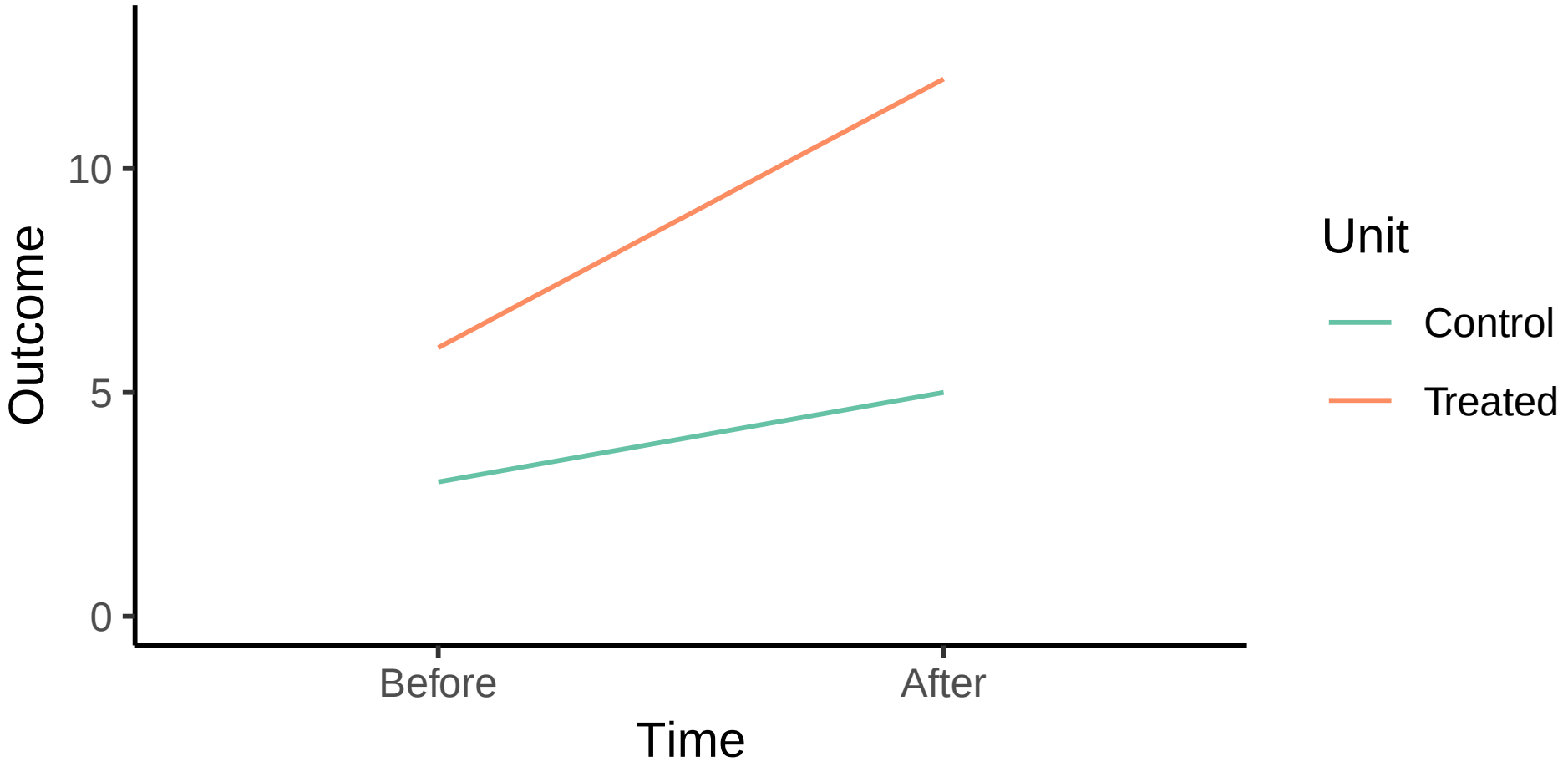

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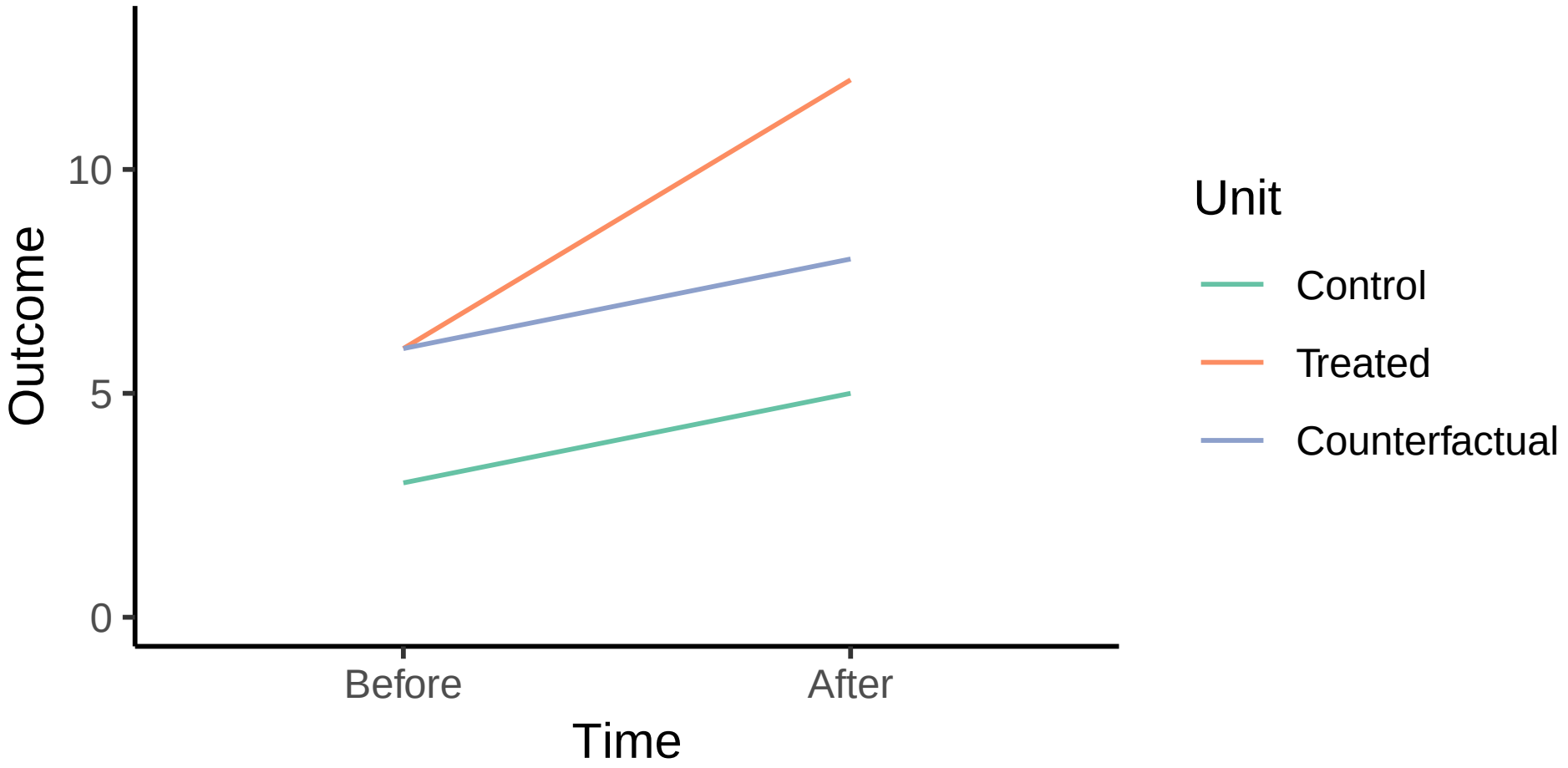

Estimating Difference-in-Differences

- Regression for the cross-unit effect of treatment

$$Y_{it} = \alpha + \gamma D_i$$

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- The difference-in-differences estimate is just the *interaction* of time and treatment status

$$Y_{it} = \alpha + \gamma D_i + \delta T_t + \beta D_i * T_t$$

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- β is our **Average Treatment Effect** estimate

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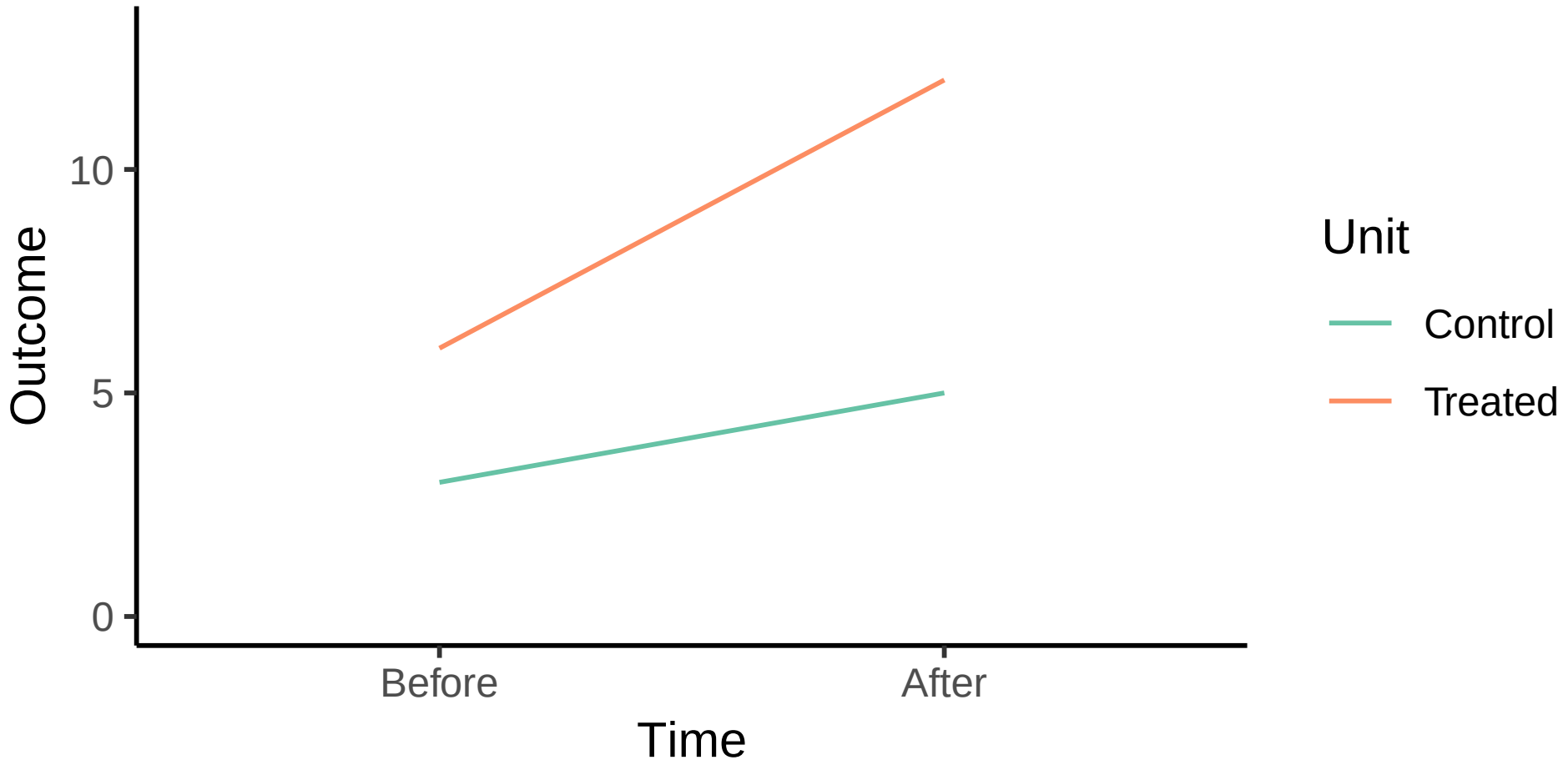
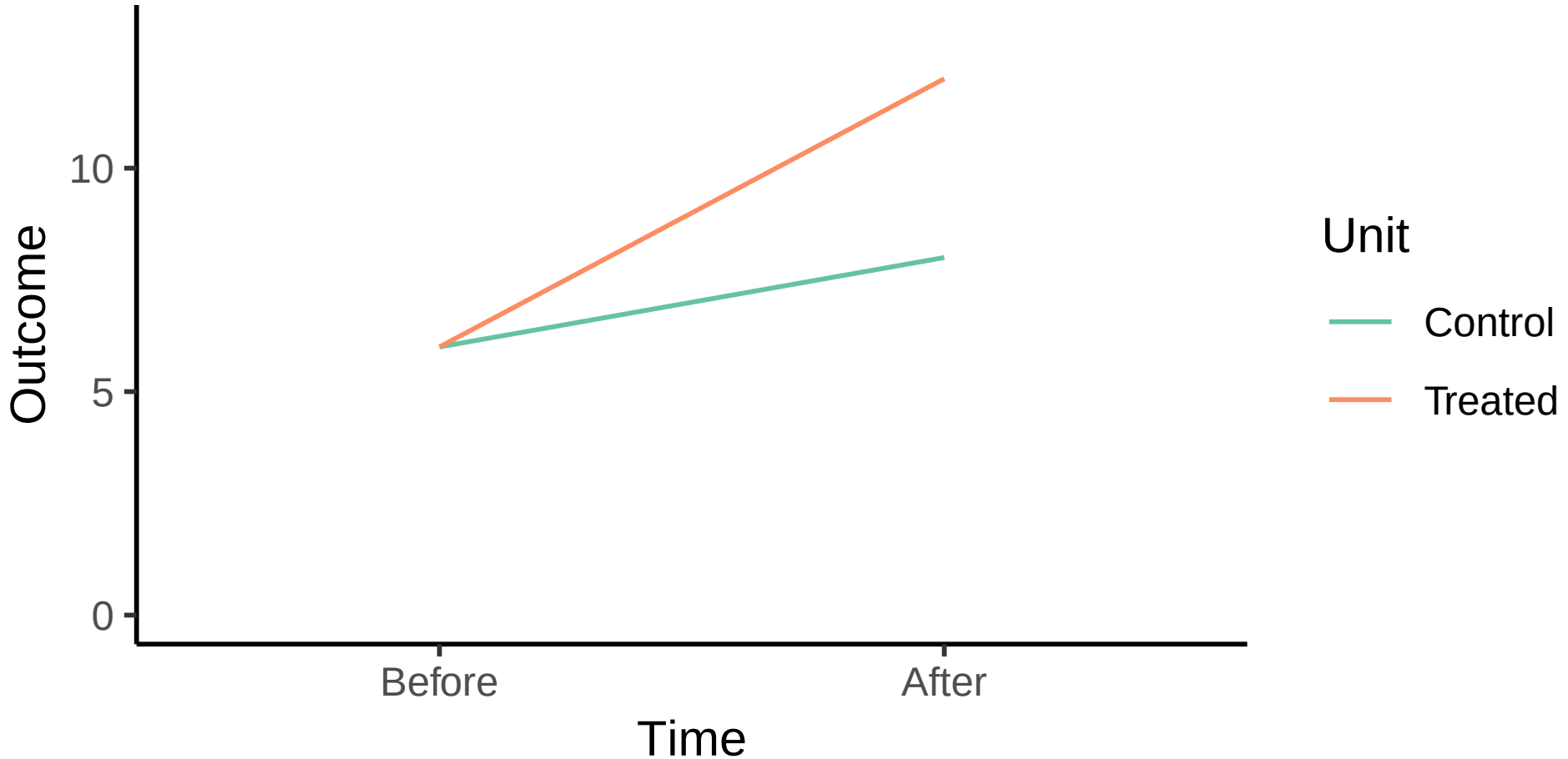
Difference-in-Differences

Raw Data:



Difference-in-Differences

Add a variable (fixed effect) for treated/control:



Difference-in-Differences

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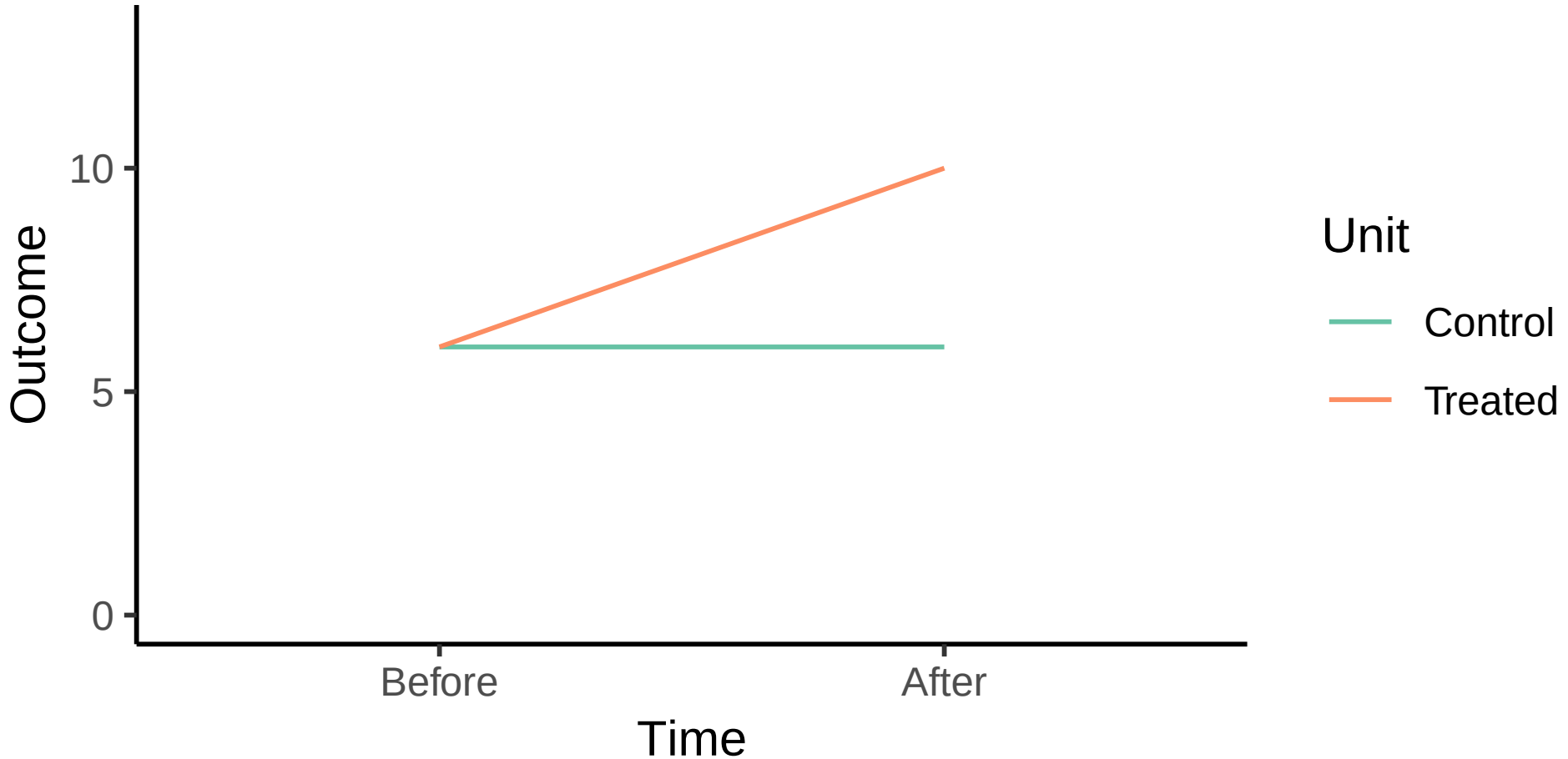

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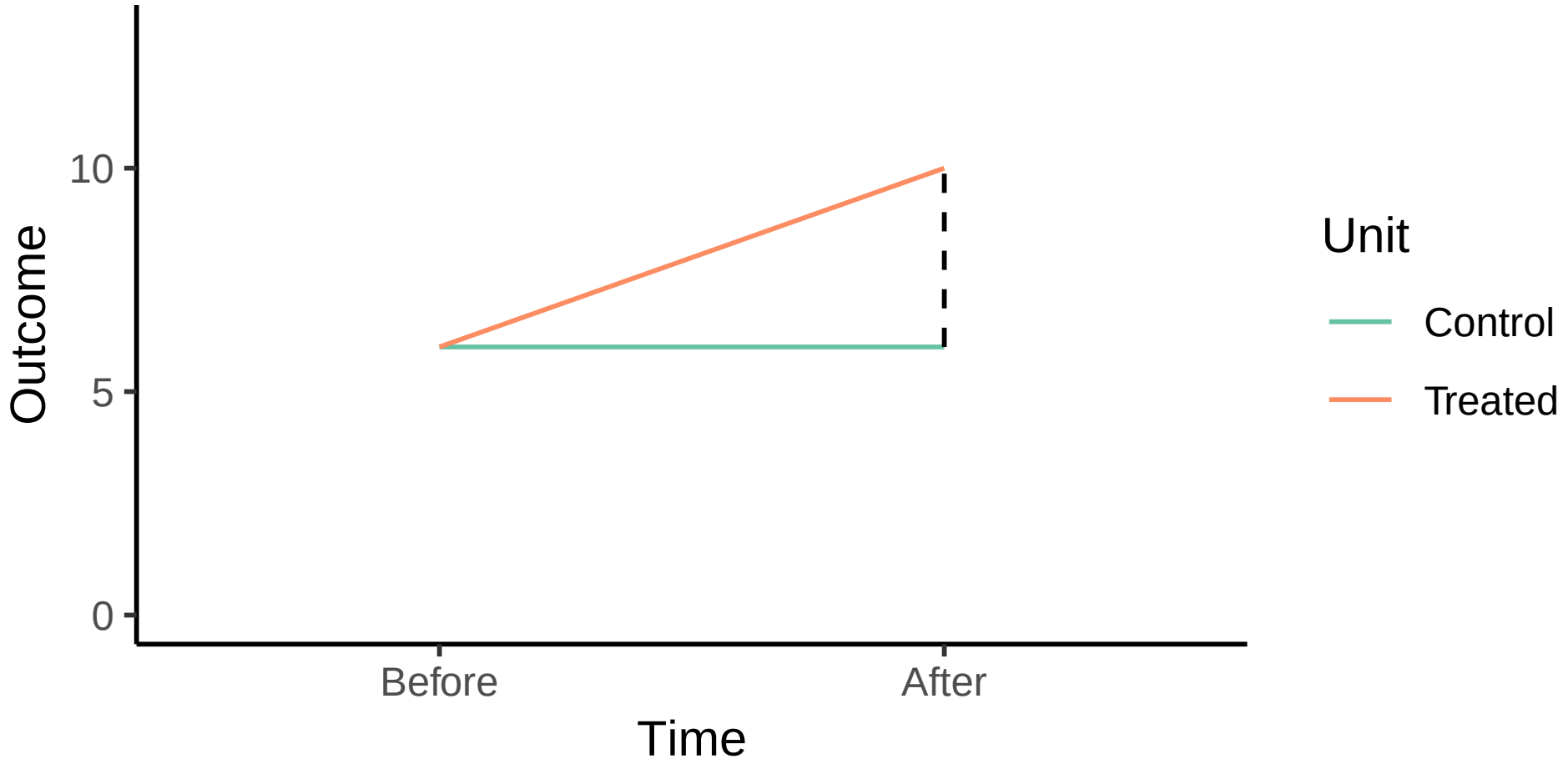

Estimating Difference-in-Differences

- With time-series data, we have temporal autocorrelation

Estimating Difference-in-Differences

- With time-series data, we have temporal autocorrelation
- Crucial to cluster standard errors by each cross-sectional unit (eg. each country)

Difference-in-Differences

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- One test of this is to check if **pre-treatment trends are parallel**

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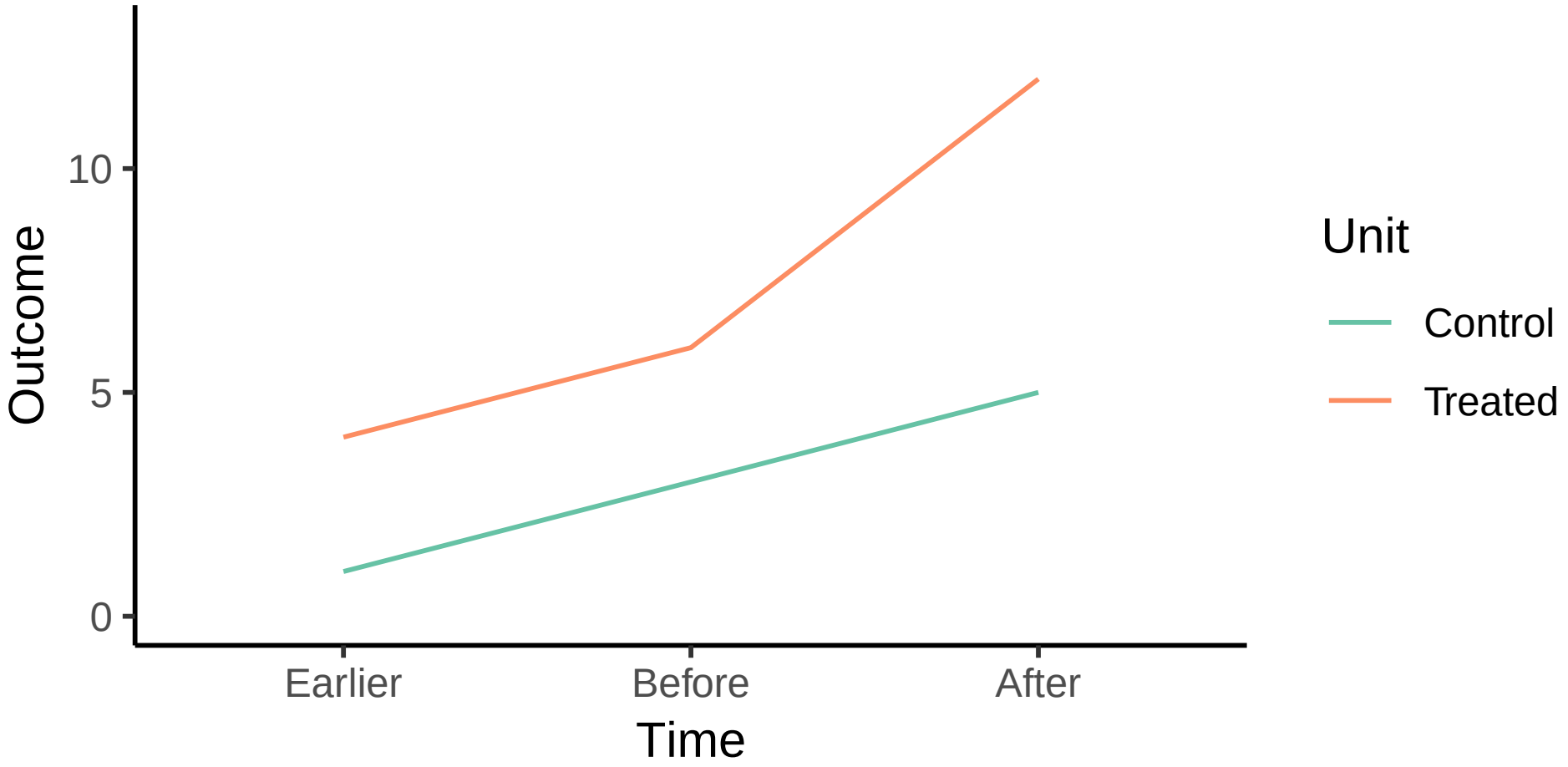

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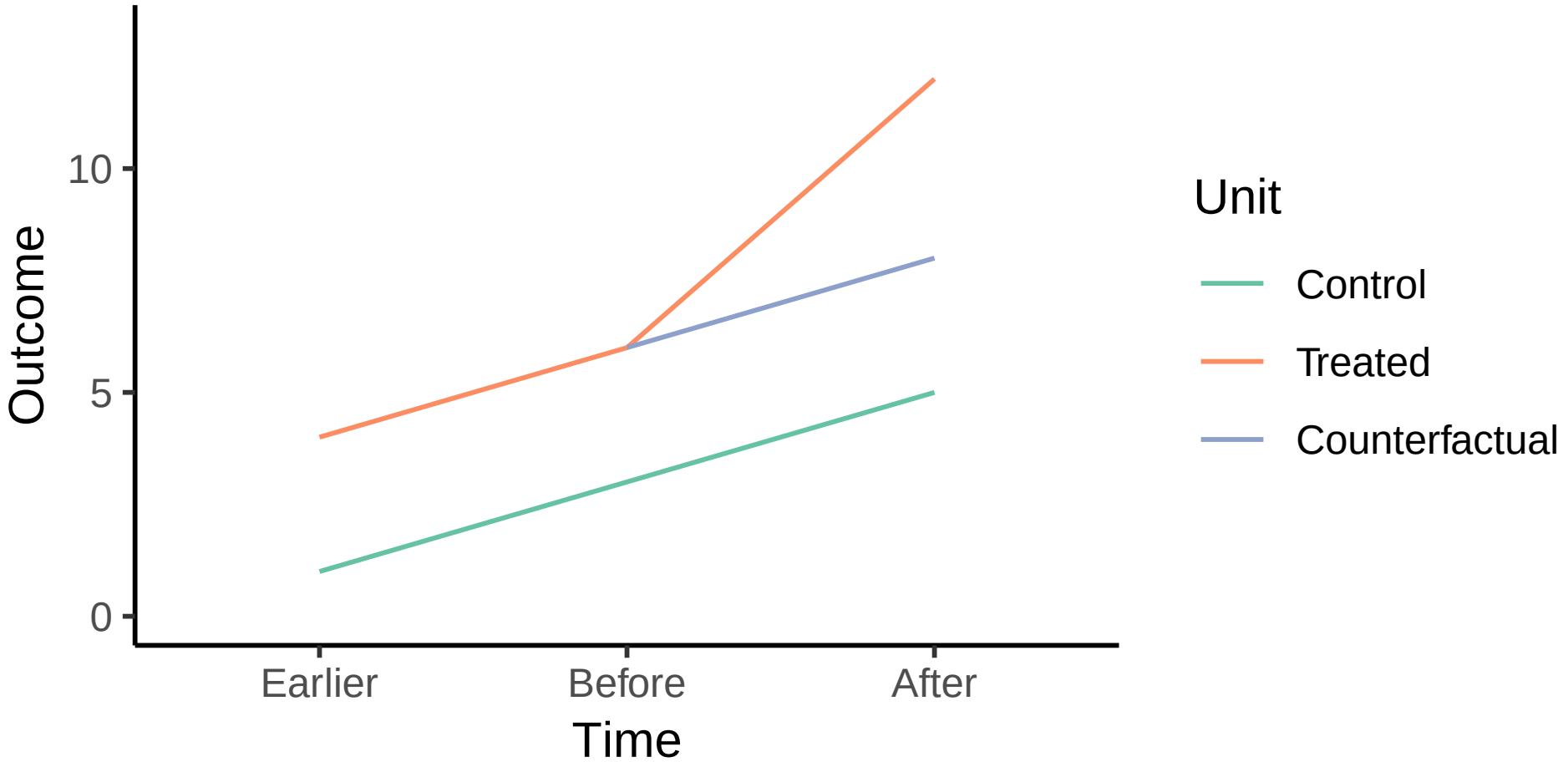

Difference-in-Differences Assumptions

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2. **No compound treatment**
3. **No spillovers** (SUTVA)
4. **Group membership is stable** (no migration from control to treatment)

Section 2

The Effect of Illegal Activities on Violence

Chimeli and Soares 2017

- How does an activity being illegal affect violence?

Chimeli and Soares 2017

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- How did Brazil's ban on mahogany affect homicides?

Chimeli and Soares 2017

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Chimeli and Soares 2017

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- What are the challenges to explanation?
  - Omitted variables, eg. State capacity
  - Overall trends, eg. national decrease in homicides
- Comparing the *change* in violence in mahogany-growing areas to the change in violence in non-mahogany areas

Chimeli and Soares 2017

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Chimeli and Soares 2017

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- **Before:**

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- **Before:** Pre-1999
- **After:**

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- **Before:** Pre-1999
- **After:** Post-1999
- **Outcome:**

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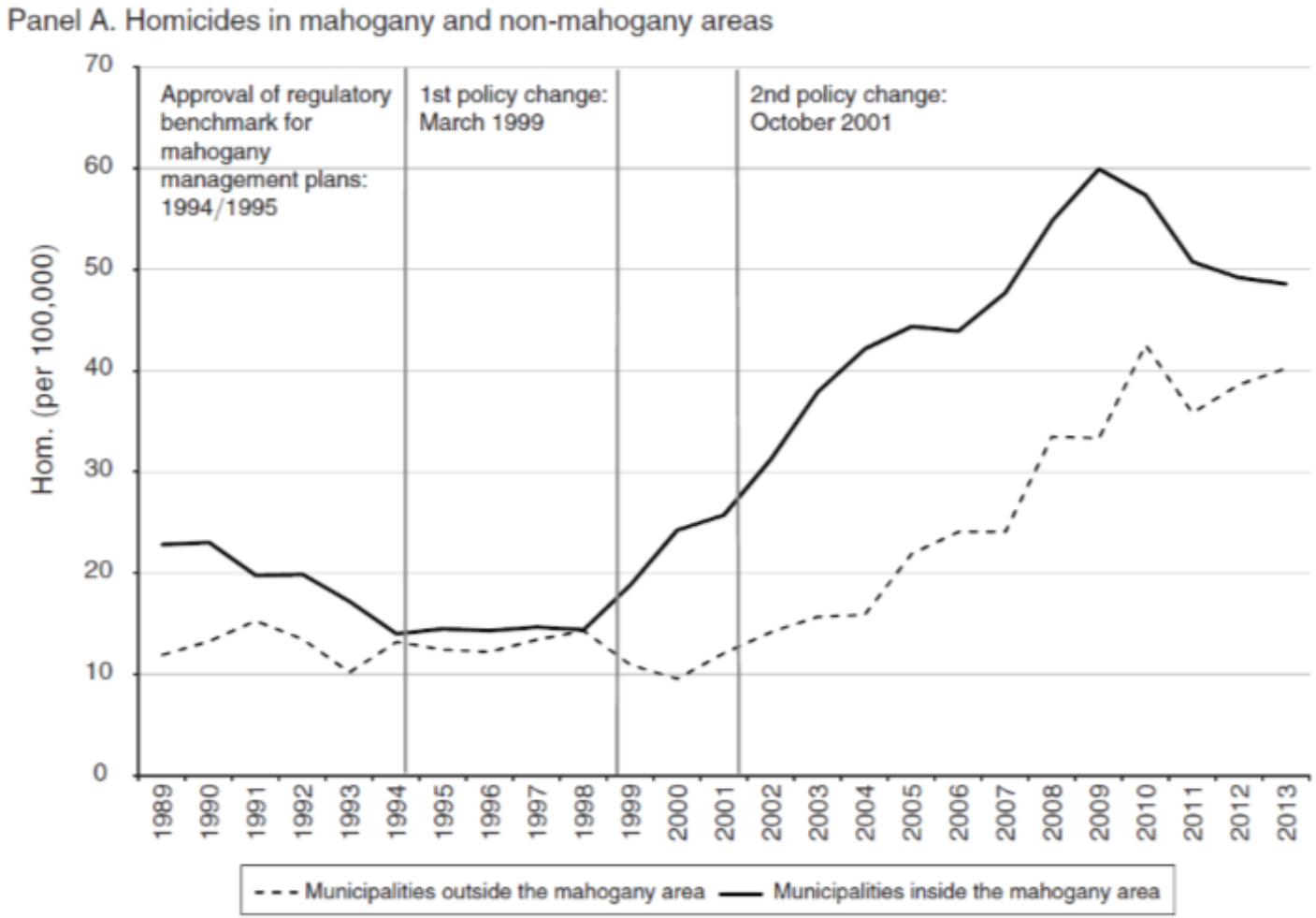
- So what are treatment and control here?
- **Treatment:** Municipalities with mahogany
- **Control:** Municipalities **without** mahogany
- **Before:** Pre-1999
- **After:** Post-1999
- **Outcome:** Homicides per 100,000 people

Chimeli and Soares 2017

- Multiple treatment timings:
  - Partial Ban on Mahogany exports
  - Full Ban on Mahogany exports
  - 'Reverse' treatment: Better policing of mahogany regulations

Difference-in-Differences



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Apply more complex state-specific trends for covariates to minimize risk of non-parallel trends

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Cluster standard errors by municipality

Apply more complex state-specific trends for covariates to minimize risk of non-parallel trends

Supporting evidence: The 'extra' homicides were the type we'd expect from illegal activity

Chimeli and Soares 2017

- Interpretation

Chimeli and Soares 2017

- Interpretation
  - Illegal activity prevents ’peaceful’ contract enforcement
  - Competition between loggers
  - Contract enforcement with buyers
  - Intimidation of communities to not report logging