

SP25 7130: Final Exam

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1 Question 1.1 & 1.2

(1) Solution:

Table 1: Descriptive Statistics: Full Sample vs. ISO 14001 Certification

Variable	Full Sample					Certified					Non-Certified				
	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N
Toxic Releases	2.384	1.053	0	10	100	1.895	1.150	0	7	50	2.780	1.300	0	10	50
Sales	15.2	8.3	2	50	100	16.5	7.9	2	40	50	14.0	8.6	2	50	50
R&D Expenditure	5.1	2.7	1	15	100	5.8	2.5	1	12	50	4.4	2.9	1	15	50
Inspections	3.6	1.9	0	8	100	4.1	2.0	0	8	50	3.2	1.8	0	8	50

2 Question 1.3

(3) Solution:

Table 2: Two-Way Fixed Effects Model

<i>Dependent variable:</i>	
log_releases	
iso14001	0.009 (0.015)
insp	−0.083*** (0.007)
rd	−0.0001 (0.0002)
sales	−0.00001 (0.00001)
Observations	8,000
R ²	0.357
Adjusted R ²	0.285
Residual Std. Error	0.314 (df = 7187)
<i>Note:</i> *p<0.1; **p<0.05; ***p<0.01	

3 Question 1.4

(4) Solution:

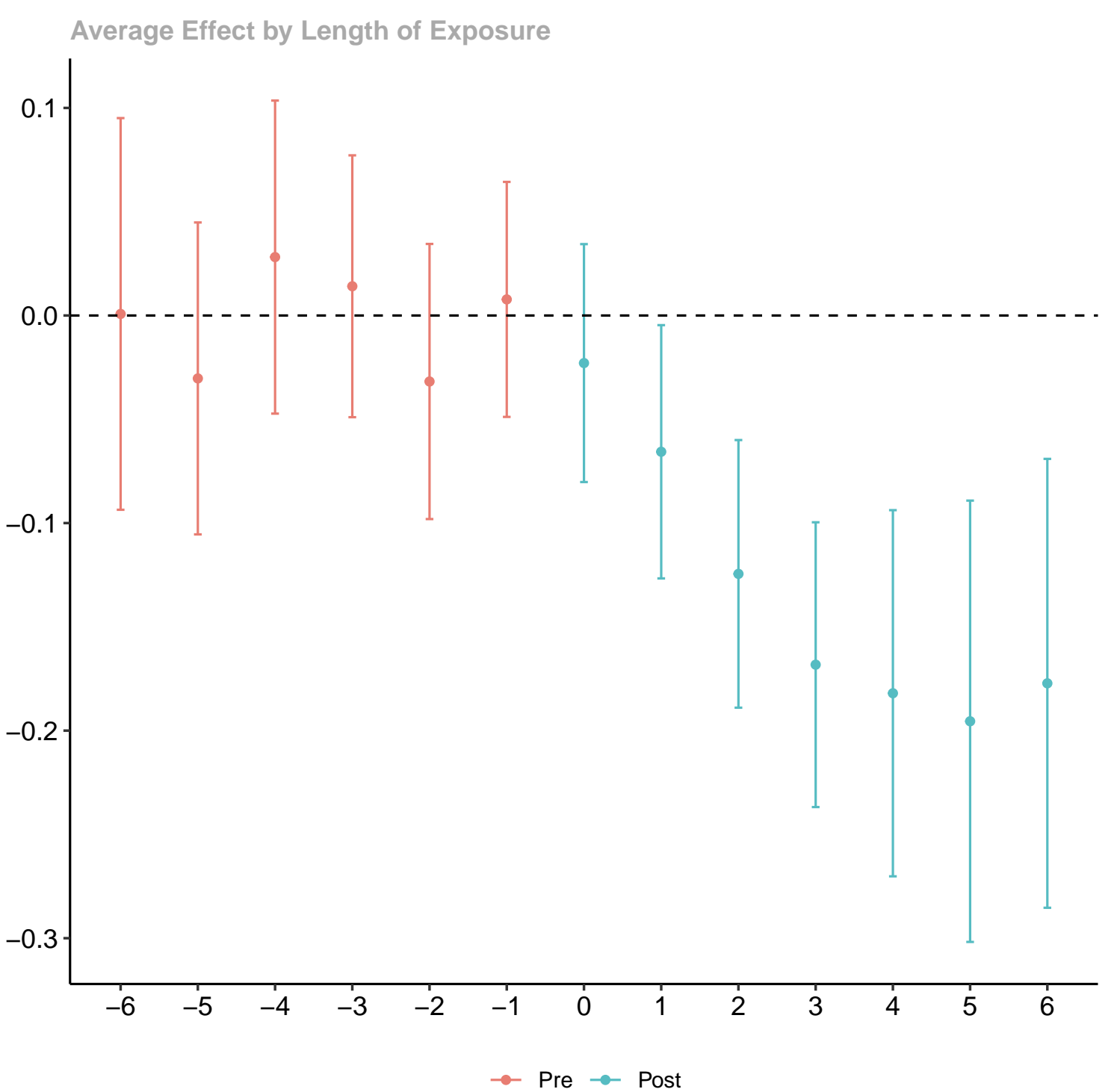
Table 3: CS DiD: Overall Group-Averaged ATT

	Model	ATT	SE
1	No Controls	-0.147	0.044
2	With Controls	-0.130	0.052
3	No Controls	-0.119	0.057
4	With Controls	-0.200	0.055
5	No Controls	-0.068	0.050
6	With Controls	-0.105	0.054
7	No Controls	-0.039	0.057
8	With Controls	0.031	0.062
9	No Controls	-0.041	0.067
10	With Controls	-0.149	0.044
11	No Controls	-0.129	0.051
12	With Controls	-0.119	0.059
13	No Controls	-0.201	0.053
14	With Controls	-0.069	0.048
15	No Controls	-0.113	0.052
16	With Controls	-0.048	0.060
17	No Controls	0.028	0.056
18	With Controls	-0.076	0.063

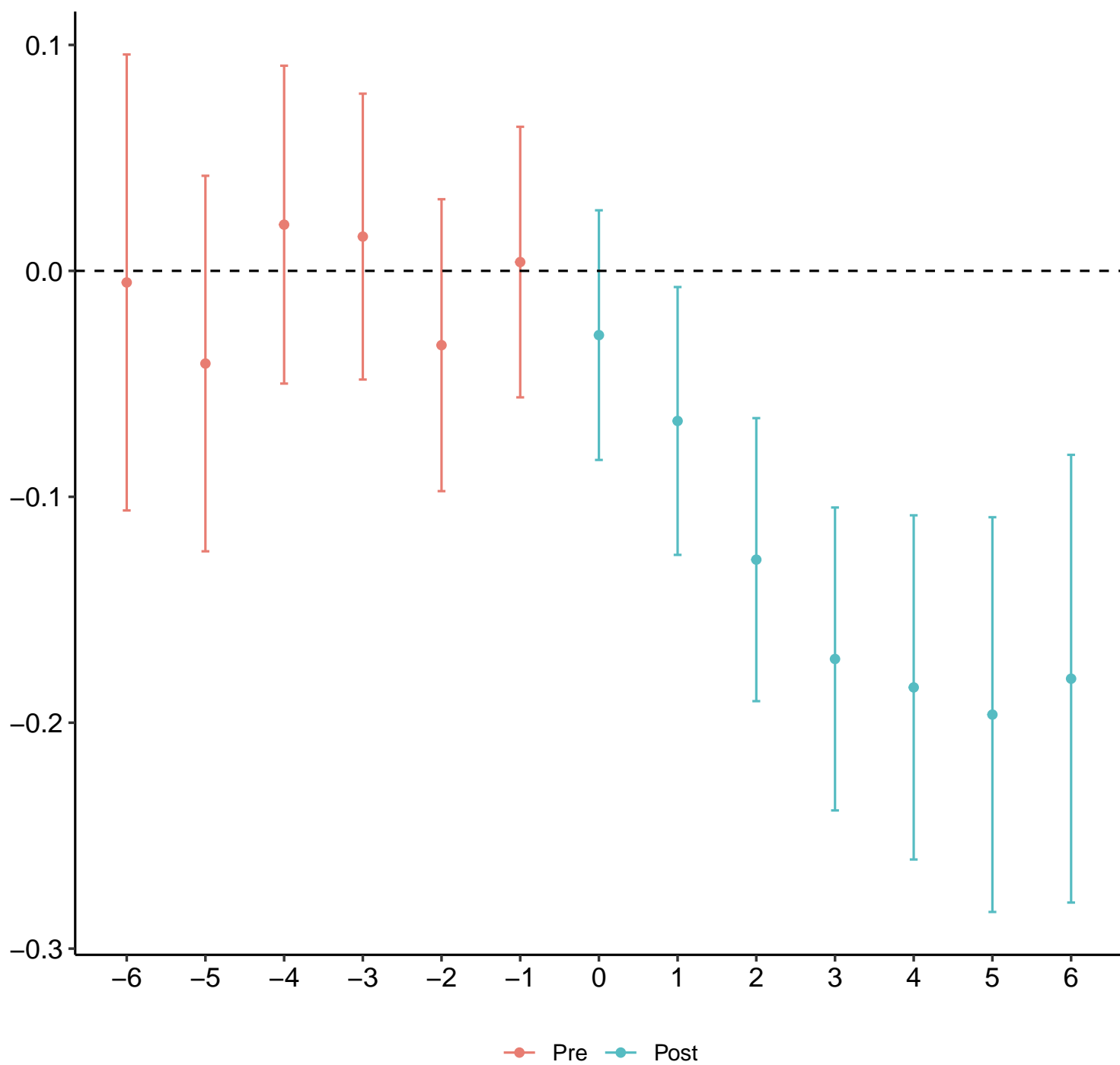
4 Question 1.5

(5) Solution:

4.1 Event-Study Analysis



Average Effect by Length of Exposure



4.2 Interpretation and Discussion

In this section, we interpret and discuss the overall results obtained from the descriptive statistics, the TWFE model, and the Callaway & Sant'Anna (CS) difference-in-differences estimator.

4.3 Descriptive Statistics

- **Mean Levels of Key Variables:** The descriptive tables show that firms with ISO 14001 certification have (on average) ...
- **Differences Between Certified and Non-Certified:** Comparing means for toxic releases, sales, R&D, and inspections suggests ...
- **Potential Selection Issues:** If large pre-treatment differences exist between certified and non-certified firms, it may indicate that firms adopting ISO 14001 differ systematically from those that do not.

4.4 TWFE Model

- **Coefficient on `iso14001`:** The TWFE model estimates that obtaining ISO 14001 certification is associated with a coefficient of approximately $\hat{\beta}$ on $\ln(\text{toxic releases})$. Interpreted in percentage terms, this implies about $(e^{\hat{\beta}} - 1) \times 100\%$ change.
- **Control Variables:** The coefficients on `sales`, `rd`, and `insp` provide insight into how these factors correlate with log toxic releases, holding firm and year fixed effects constant.
- **Limitations of TWFE with Staggered Adoption:** Because ISO 14001 adoption is staggered across firms, a single two-way fixed effects model may suffer from bias if the parallel trends assumption is violated or if treatment effects vary by cohort and time since adoption.

4.5 CS DiD (Staggered Adoption)

- **Overall Group-Averaged ATT:** The Callaway & Sant'Anna (CS) estimator provides a more flexible approach to staggered adoption. Our aggregated results suggest an average treatment effect on the treated (ATT) of ...
- **Event-Study Analysis:** The dynamic/event-study results show how toxic releases evolve before and after certification. Specifically, for periods $-k$ to $+k$ relative to adoption, we observe ...
- **Comparing No-Controls vs. With-Controls:** Including `sales`, `rd`, and `insp` as covariates changes (or does not change) the estimated ATT, suggesting that these variables are (or are not) important confounders.

4.6 Concerns and Limitations

- **Parallel Trends Assumption:** Even with the CS approach, we rely on the assumption that, within each cohort, the outcome trends would have been parallel in the absence of treatment. Visual inspection of the event-study plots helps check for pre-trend violations.
- **Measurement Error:** If `releases`, `sales`, `rd`, or `insp` are measured with substantial error, it could bias our estimates.
- **Selection on Unobservables:** Firms may choose to adopt ISO 14001 at times correlated with unobserved productivity or regulatory pressure, challenging the DiD assumptions.
- **External Validity:** Our results are specific to the sample of firms studied. Extrapolating to other industries, regions, or regulatory contexts should be done with caution.

In summary, the descriptive statistics, TWFE regression, and CS DiD analysis suggest that ISO 14001 certification is associated with ... (summarize your main takeaway). However, the staggered nature of adoption, potential pre-trend differences, and unobservable firm characteristics should be kept in mind when interpreting these results.