

Final Exam

Use a software of your choice to answer the empirical questions. Be sure to upload your code and answers to Carmen. This assignment must be completed entirely independently.

First introduced in 1996 by the International Organization for Standardization (ISO), the ISO 14001 standard is a voluntary program intended to improve environmental performance that has been widely implemented by firms throughout the world. Per the 2020 ISO survey, ISO 14001 certified firms can be found in 194 countries and territories, with the total number of certificates reaching 348,473 in 2020. The purpose of this assignment is to study the polluting behavior of (medium to large) manufacturing firms with a focus on the relationship between ISO 14001 certification and the emission of toxic pollutants. The dataset to be used for the empirical analysis (*finalsp25dataset.csv*) is available on Carmen. The variables are described in the table below. Using the provided dataset, do the following:

- (1) Replace the few missing values for toxic releases (coded as zeroes in the dataset) with the firm-level average releases in the sample.
- (2) Provide descriptive statistics i) for the full sample and ii) broken by ISO 14001 certification status in one table. Be sure to include p-values for the tests that the means of the variables are the same for ISO14001 certified and non-certified firms.
- (3) Run the conventional two-way fixed effects (TWFE) model with log of toxic releases as the dependent variable, ISO14001 as the “treatment variable” and environmental inspections, R&D expenditure, and sales as controls.
- (4) Given the staggered nature of ISO 14001 certification, re-do question (3) using the Callaway and Sant’Anna (CS) difference-in-differences estimator (covered in class/lab) rather than the TWFE model. Estimate the model with and without controls. You will need to create a variable that represents, for each firm, the first year since certification. This variable is required in order to run the CS estimator.
- (5) Report all results (descriptive statistics, TWFE and CS estimations) in professionally-styled tables. Also report the CS results graphically as well, using an event window of ± 6 . Interpret/discuss the overall results obtained from questions 1 to 4, including any concerns you have about the model, data and estimation methods.

Variable name	Definition
firm_id	Unique identifier of the firm.
year	Year when the data is recorded.
releases	Total releases of toxic chemicals at the firm level, in millions of lbs. Many are classified as carcinogenic to humans by the International Agency for Research on Cancer.
iso14001	Dummy variable = 1 if a firm is ISO 14001 certified at time t, 0 otherwise
sales	Firm-level sales, in millions
rd	Firm-level R&D expenditures, in millions
insp	Number of on-site inspections by environmental regulators, firm-level