

Problem Set 07

Synthetic Control Method (SCM)

TAs: Aida Hatami, Sam Fathinejad, Fatemeh Salehi, Reza Sahour

May 16, 2025

Problem 1 – Synthetic Control Method in Practice

Answer the following sub-questions based on your readings of Farzanegan (2022) and Farzanegan (2021):

- (a) Formulate the precise causal question addressed in each of the two papers. Then, explain why the synthetic control method is particularly well suited for answering each question, in contrast to a classic Difference-in-Differences (DiD) design.
- (b) Propose a new policy-relevant question specifically related to Iran that could be evaluated using the SCM framework, but with a different outcome variable or dataset than those used in Farzanegan (2022, 2021). Your response should include:
 - Why SCM is appropriate for this new setting
 - What potential data sources might be suitable
 - What potential weaknesses or limitations may arise in this application
- (c) Demonstrate that if the synthetic control assigns a weight of 1 to a single donor country (and 0 to all others), the estimator reduces to a simple pre-post comparison. Then, identify under what type of error covariance structure this approach would be least efficient, and explain why.
- (d) Farzanegan (2022) restricts the donor pool to 11 MENA/OPEC countries, while Farzanegan (2021) uses 12 such countries, excluding those affected by the Arab Spring.
 - Summarize the criteria used for inclusion or exclusion in each case.
 - Critically assess whether these criteria satisfy the No Anticipation Assumption and whether they introduce any risk of selection bias.
- (e) Discuss how each paper defends its key identification assumptions, including:
 - The absence of unobserved time-varying confounders
 - No interference between units (SUTVA / no spillovers)
 - Stability of the relationship between covariates and outcomes in the pre-treatment period

Evaluate whether the justification is equally convincing for both outcome variables (GDP vs. military spending). Explain why or why not.

- (f) Explain how spillover effects among OPEC members (e.g., through oil market coordination or shared trade shocks) might violate SCM assumptions. Then, propose one robustness check that could detect or mitigate such violations, and describe how it would be implemented.

Problem 2 – Coding Assignment: Reunification of Germany (1990)

Using panel data on West Germany and 16 OECD countries from 1960 to 2003, we applied the synthetic control method (SCM) to evaluate the economic impact of the 1990 German reunification. The goal is to replicate and interpret results similar to those in Abadie, Diamond, and Hainmueller (2015), *Comparative Politics and the Synthetic Control Method*. Answer all sub-questions using appropriate code, output, and interpretation.

- (a) Construct a synthetic control for **West Germany**, treating 1990 as the intervention year. Use the following covariates: `metric_inflation`, `trade`, `metric_education`, and `metric_industry_share`. Handle missing data appropriately.
- (b) Plot the **original**, **pointwise**, and **cumulative** gaps between the treated and synthetic units. Briefly interpret the post-treatment gap.
- (c) Report and interpret the **covariate balance table** and **donor weights**. Which donor countries received the most weight and do these match your expectations?
- (d) Perform a **in-time placebo test** by repeating the SCM with 1982 as a false treatment year. Plot the placebo gap and compare it to the true treatment gap. What does this test imply about the validity of the model?
- (e) Conduct a **in-space placebo test**:
- Re-run the SCM treating each control country as if it were treated in 1990.
 - Plot all **gap trajectories** over time, including the actual trajectory of West Germany.
 - Filter out units with poor pretreatment fit (e.g., $\text{pre-RMSPE} > 20 \times \text{West Germany}$).
 - This figure should resemble **Figure 4** in Abadie et al. (2010), which illustrates the effect of California's tobacco control program.
- (f) Create a **bar plot of post/pre RMSPE ratios** for all units in the donor pool, highlighting West Germany. Estimate and report the empirical **p-value**: what fraction of placebo units had higher RMSPE ratios than West Germany?