SCM application to environmental analysis

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Contents

Abstract

Lorem ipsum

1 Introduction

Lorem ipsum

2 Synthetic Control Methods

Synthetic Control Methods (SCM) have been originally proposed in Abadie and Gardeazabal (2003) and by Abadie et al. (2010) to estimate the effects of aggregate interventions. The key idea behind the method is that, when units are a few aggregate entities, a better counterfactual than using any single unit can be derived by computing a combination of the untreated units that closely resembles the treated one, i.e. a "synthetic control". The selection of the "donor units" is formalized with a data driven procedure. Although the method was originally intended for samples with few units, it has been successfully applied in contexts with large samples, for instance in Acemoglu et al. (2016). Such a synthetic control unit is computed as a weighted average of all potential comparison units that best resemble the treated units. In this section, I will introduce the method and explore feasibility, data requirements and methodological issues. The main references are Abadie and Gardeazabal (2003) and Abadie, Diamond and Hainmueller (2010), which introduced the method in the literature, and Abadie (2021), which provides a useful guide to the application of SCM.

2.1 Setting of SCM

Suppose to have data for $j = 1, .., J+1$ units, and suppose that unit $j = 1$ is the treated unit. The "donor pool" of untreated units which will contribute to the construction of a synthetic control for unit $j = 1$ is then constituted by the remaining $j = 2, ..., J + 1$ units. Assume that data covers T periods, with periods up to T_0 being the pre-intervention observations.

For each unit j at time t data is available for the outcome of interest Y_{jt}, and for a number k of predictors $X_{1j}, ..., X_{kj}$. Define the $k \times 1$ vectors $\mathbf{X}_1, ..., \mathbf{X}_{J+1}$ which contain values of the predictors for units $j = 1, ..., J + 1$. Define the $k \times J$ matrix $\mathbf{X}_0 = \mathbf{X}_2, ..., \mathbf{X}_{J+1}$ which collects values of the predictors for the untreated units. For each unit j, define the potential outcome without treatment as Y_{jt}^N. For the trated unit $j = 1$, define the potential response under the treatment as Y_{jt}^I in the post treatment period $t > T_0$. The effect of the intervetion for the affected unit $j = 1$ for $t > T_0$ is:

$$\tau_{1t} = Y_{1t}^I - Y_{1t}^N$$

.

For the treated unit, Y_{1t}^I is observed so that $Y_{1t} = Y_{1t}^I$, but Y_{jt}^N is not. SCM provides a way to estimate Y_{jt}^N for $t > T_0$, that is, how the outcome of interest would have been in the absence of treatment. Notice that τ_{1t} is allowed to change over time.

2.2 Estimating

3 Literature review and general applications in macro

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4 Potential applications to Fleurbeay project

Lorem ipsum

5 Data sourcing and explanations

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6 Conclusion

Lorem ipsum

7 References

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