

Synthetic Control Method [Replication]

December 25, 2019

Comparative Politics and the Synthetic Control Method Replication

Taha Bouhoun

1 Introduction

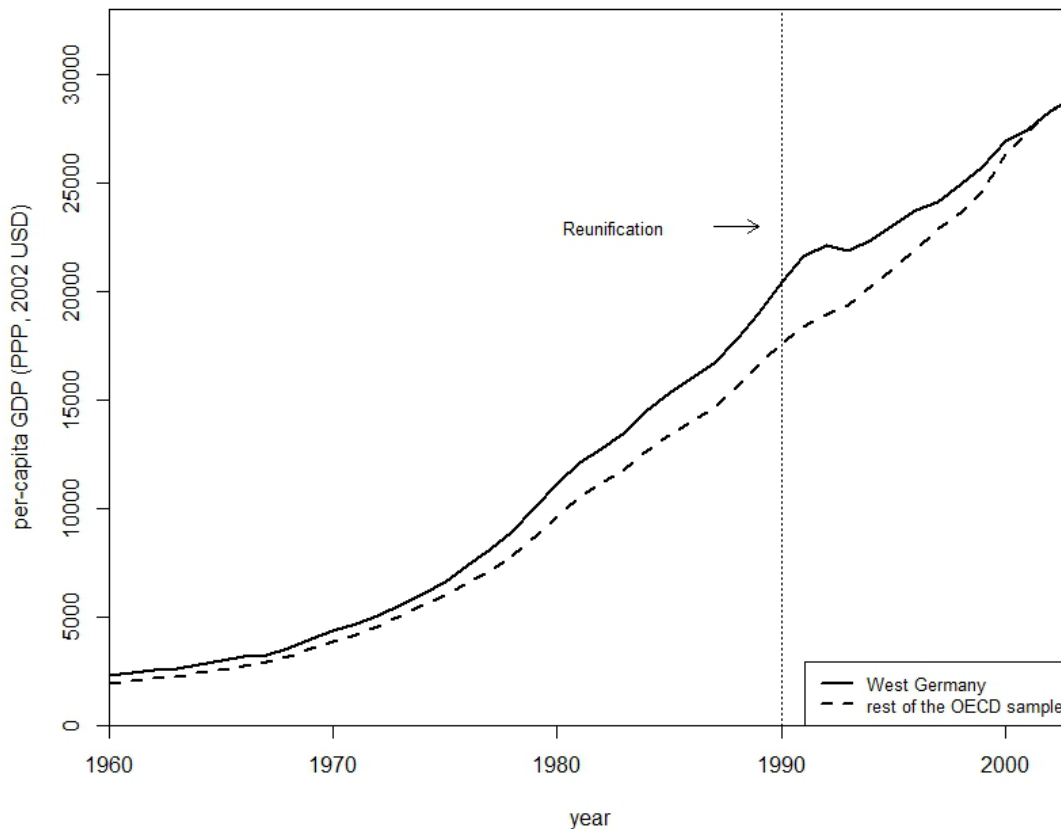
Examining the economic impact of 1990 German reunification on West Germany using the Synthetic Controls Method.

- The treated unit: West Germany
- The donor pool: OECD countries
- The time period: from 1960 to 2003 (1990 treatment year)

The table below shows the economic growth predictor means before German Reunification:

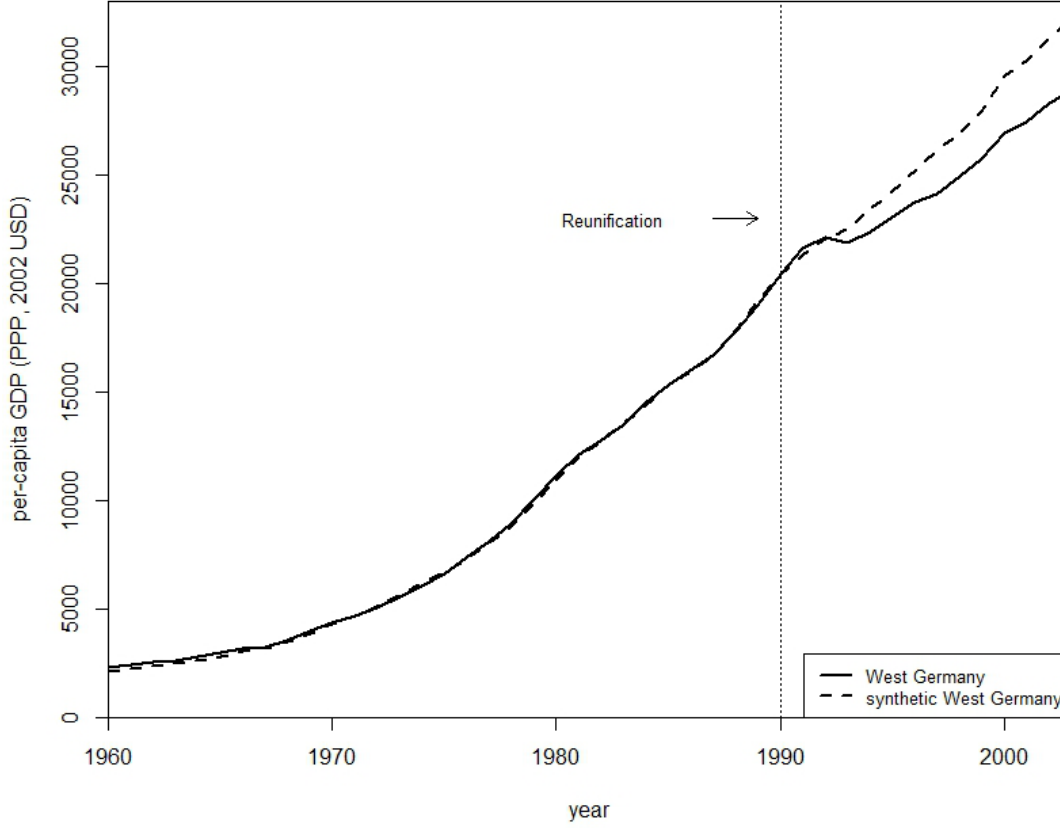
| | Treated | Synthetic | Rest of OECD Sample |
|-----------------|---------|-----------|---------------------|
| GDP per-capita | 15808.9 | 15802.2 | 8021.1 |
| Trade openness | 56.8 | 56.9 | 31.9 |
| Inflation rate | 2.6 | 3.5 | 7.4 |
| Industry share | 34.5 | 34.4 | 34.2 |
| Schooling | 55.5 | 55.2 | 44.1 |
| Investment rate | 27.0 | 27.0 | 25.9 |

Fig 1. Trend in per Capita GDP: West Germany versus the rest of the OECD countries.



2 The effect of reunification

Fig 2. Trend in per Capita GDP: West Germany versus the Synthetic version of West Germany based on the OECD countries donor pool.

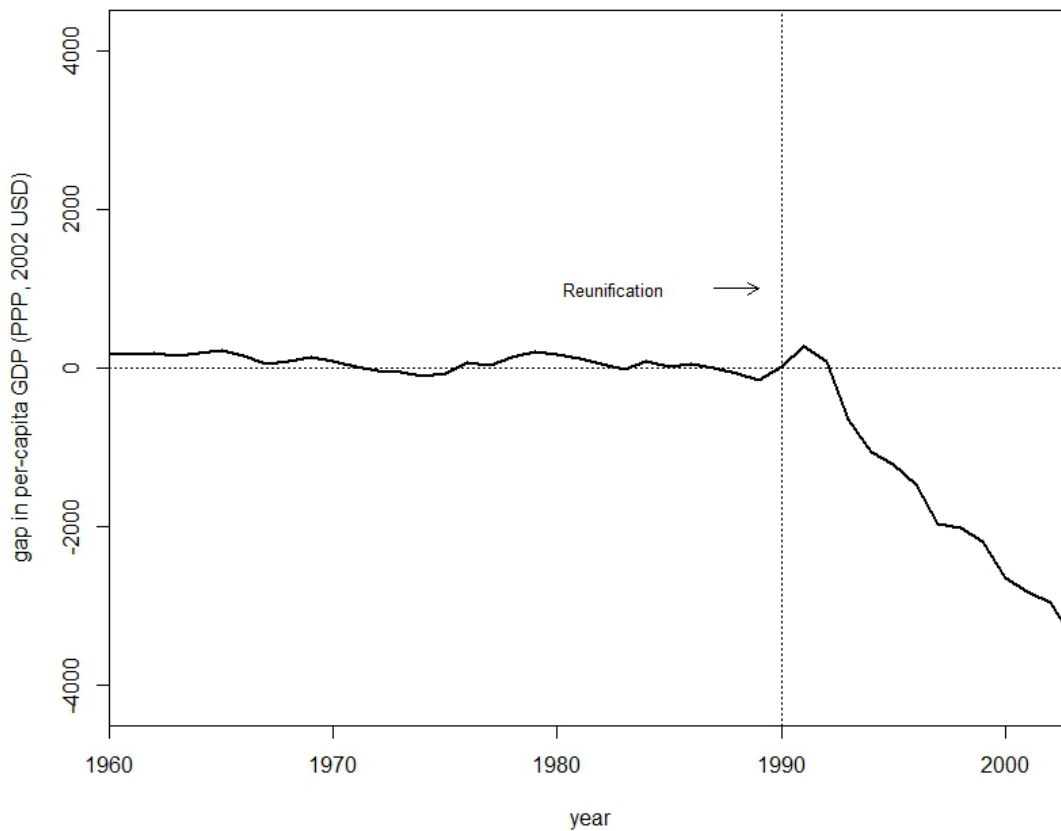


The Synthetic version of West Germany has a better fit of GDP per Capita trend of West Germany prior to the reunification as opposed to the average sample of the other OECD countries. The cross-validation technique uses the selects the weights that minimize the prediction error. The RMSPE measures the lack of fit between the outcome variable and its synthetic counterpart and defined as:

$$RMSPE = \left(\frac{1}{T_0} \sum_{t=1}^{T_0} \left(Y_{1t} - \sum_{j=2}^{j+1} w_j \cdot Y_{jt} \right)^2 \right)^{\frac{1}{2}} \quad (1)$$

Figure 2 illustrates the disparity between the real economic performance of West Germany and its synthetic version. As we can notice, the fit is consistent since 1960 but the gap starts growing right after the reunification.

Fig 3. Per Capita GDP gap between West Germany and its Synthetic version.

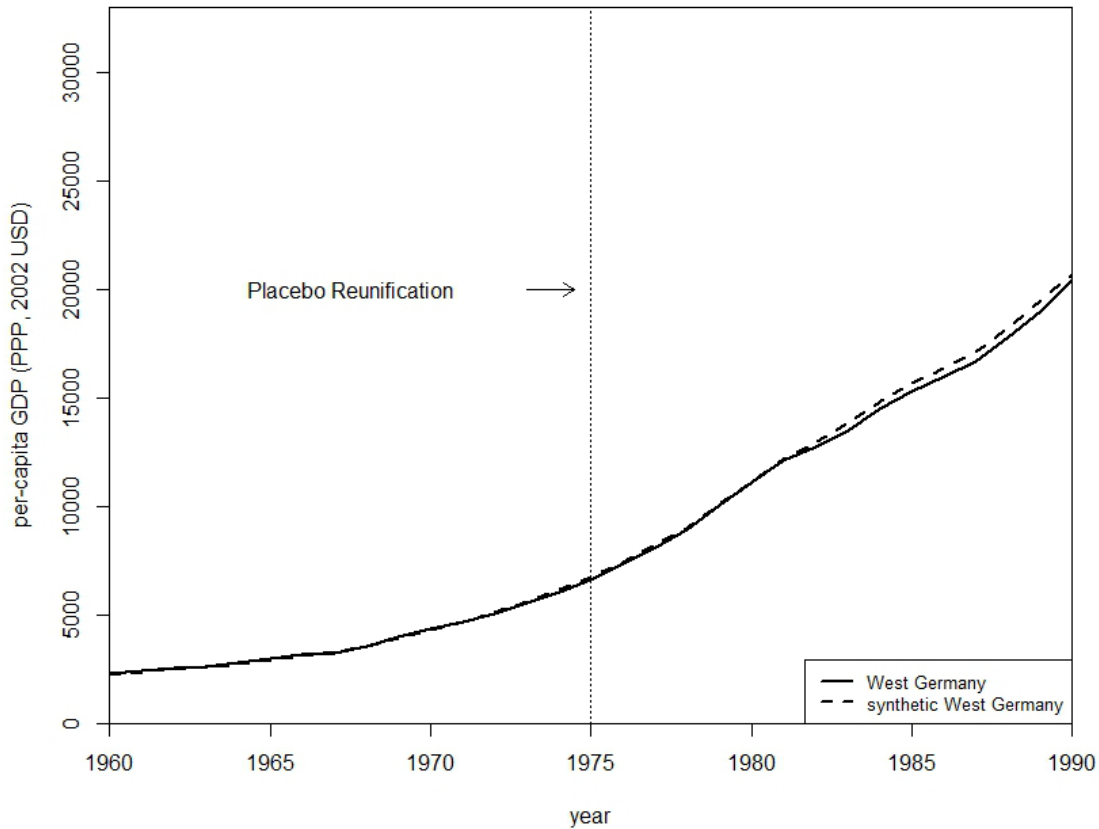


The close fit for the outcome variable in the pre-intervention period suggests that there's indeed a combination of weights of the OECD countries that would imitate the characteristics of West Germany. We notice that the unification did not have an instant effect on GDP per Capita in the first two years. The two lines, however, diverge after 1992 which highlights the negative effect of the reunification on West Germany.

Abadie et. al presented a concern about a spillover effect of the reunification on countries other than Germany but they argued that the small number of countries that constructed the synthetic control version is small enough to check for any potential bias (e.g., if the reunification negatively affected Austria, then the impact of the reunification could be underestimated. On the other hand, if the reunification positively affected economies included in the synthetic version, then the negative impact of the reunification could be overestimated)

3 Placebo studies

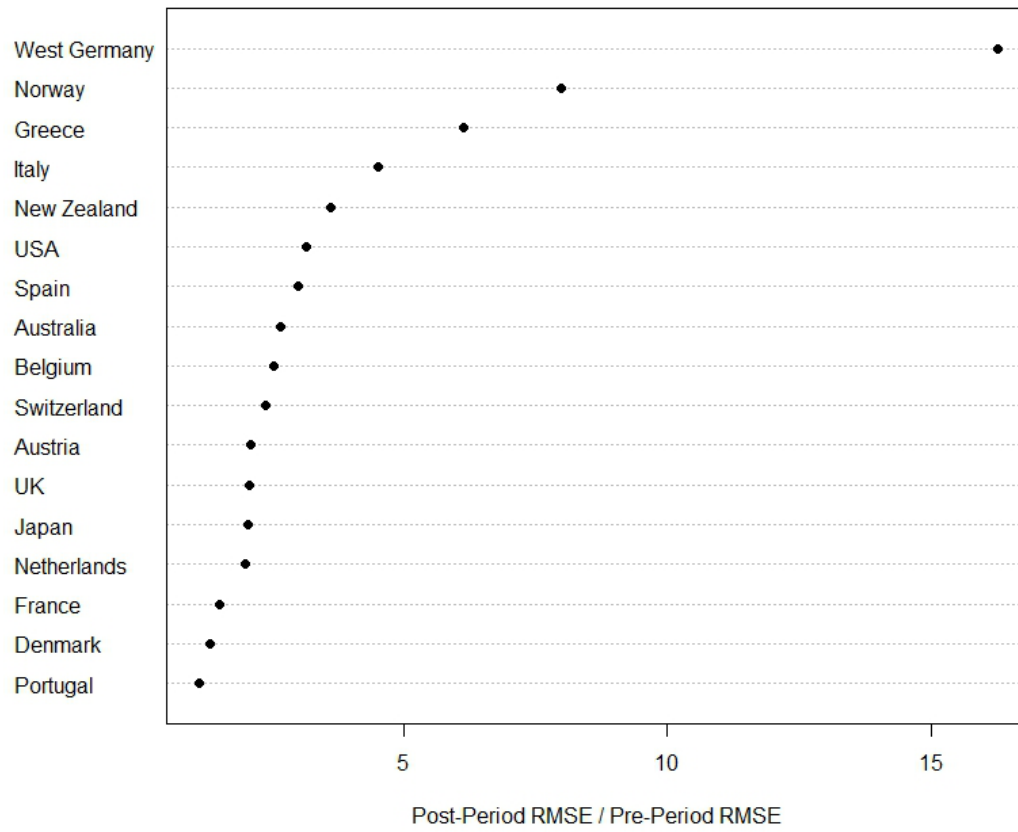
Fig 4. Placebo reunification: West Germany and its Synthetic version prior to the reunification.



The credibility of the results lies in the robustness of the model when subjected to a Placebo reunification. In this case study, Abadie et. al assigned the fake reunification to be in 1975, then -using the same cross-validation technique- we visualize the Synthetic version of West Germany against the observed data of West Germany. The two trends did not converge after 1975 (the fake reunification) which suggests that the fake reunification had no effect on the synthetic version and that the gap perceived in Fig 2. depict the effect of the real reunification.

The alternative way for a placebo test is to reassign the treatment unit to be one of the control units despite the fact that they did not undergo the treatment. This method allows us to compare the estimated effect of the reunification for each of the donor pool units against West Germany. The expectation is for the effect of West Germany to be significantly larger than any other country in the control group.

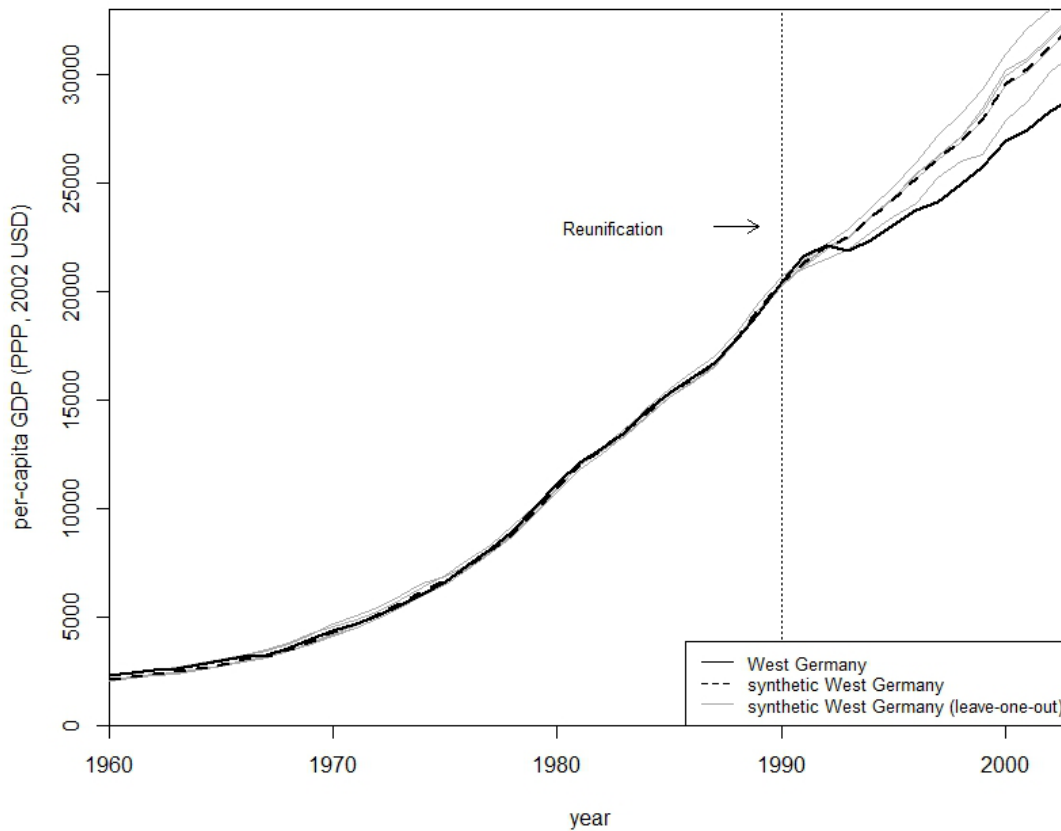
Fig 5. The ratios of Post/Pre-reunification RMSPE ¹ for West Germany and other OECD countries



¹RMSPE measures the magnitude of the gap in the outcome variable between each country and its synthetic version. In other word, the pre-intervention RMSPE over the post-intervention RMSPE for each country in the donor pool is not as large as West Germany which strengthens the argument that the effect is exclusive to that country

4 Robustness test

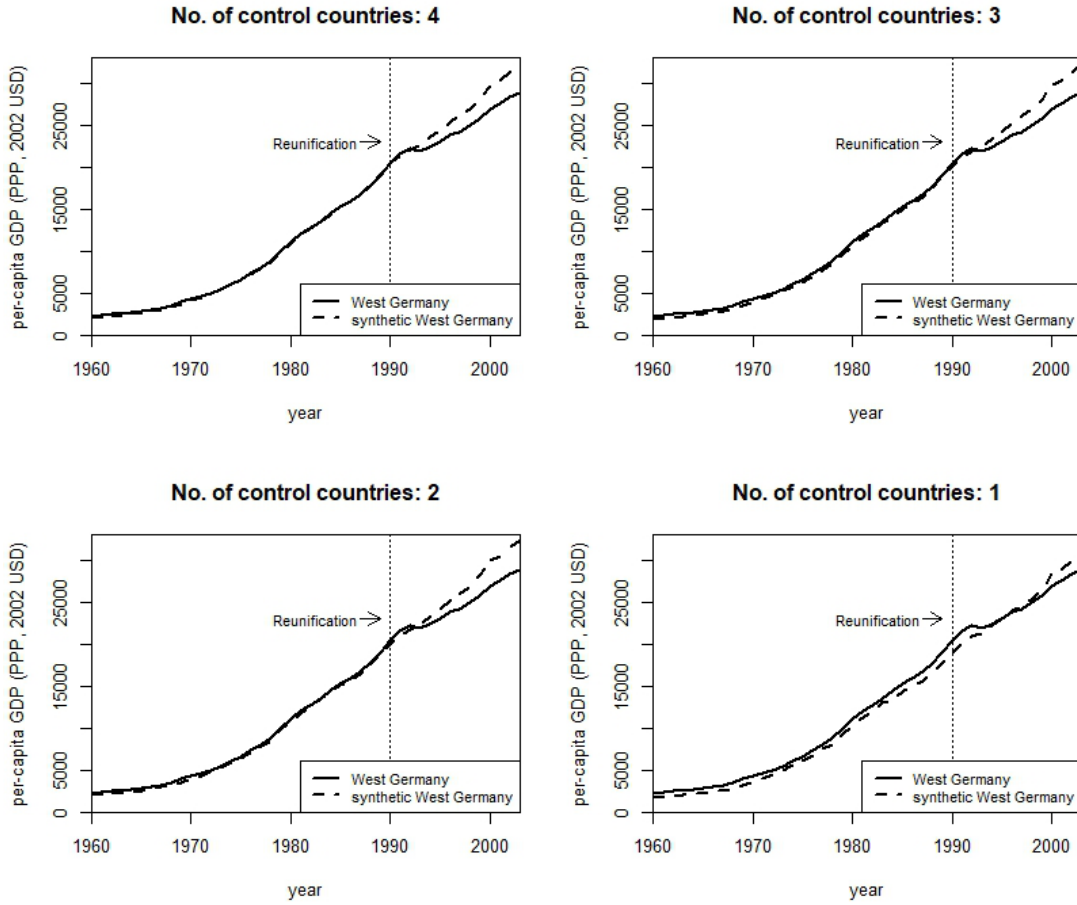
Fig 6. Leave-One-Out Distribution of the Synthetic Control for West Germany



The synthetic West Germany is estimated as a weighted average of Austria, the United States, Japan, Switzerland, and the Netherlands, with weights decreasing in this order. The robustness test is meant to check the sensitivity of the model by omitting one of the countries that received positive weights and test the goodness of fit for at each iteration.

The results illustrated in Figure 6 show that the model is robust despite excluding one of the countries from the synthetic version at each iteration. The estimates are either similar to the actual results or a bit higher but no substantial divergence noticed.

Fig 7. Per Capita GDP Gaps between West Germany and sparse synthetic controls



The baseline results is to include all the countries that are associated with positive weights (Figure 7. graph 1). However, excluding countries decreases the goodness of fit gradually until we reach the point of having one country in the control group -namely Austria- although has the largest weight compared to other countries (0.42) We notice that a combination of all four countries presents a better reference point for comparison as opposed to a single control unit.

5 Conclusion

Synthetic control method offers a new perspective of assessing the impact of an intervention without the need to look for a perfect control unit. The idea is to construct a version of the unit of interest by combining weighted units from the donor pool.

The condition is for the control units to not be subjected to the treatment (or potential spillover effects). The synthetic version, then, is subjected to the placebo and robustness test to ensure the credibility of the constructed counterfactual. The aim is to conduct a fair comparison between the treated unit and its systematically generated synthetic version.

6 References

Abadie, Alberto and Diamond, Alexis J. and Hainmueller, Jens, Comparative Politics and the Synthetic Control Method (February 1, 2014). *American Journal of Political Science*. 2014, Forthcoming; Formerly MIT Political Science Department Research Paper No. 2011-25. Available at <https://web.stanford.edu/~jhain/Paper/AJPS2015a.pdf>