The Effect of Natural Disaster on Health Expenditure in Japan: The Great East Japan Earthquake

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ABSTRACT

The Synthetic Control Method (SCM) is used to analyze the impact of the designated events like a natural disaster, political action, etc. The study applies the SCM to estimate the impact of the Great East Japan earthquake on health expenditure per capita in Japan.

For the analysis, the SCM needs two groups (Treated & Control units) and the method creates synthetic Japan from the control units. The objective of the study is to analyze the impact of the natural disaster by comparing actual Japan with synthetic Japan. The results show a significant increase in health expenditure in Japan after the earthquake.

DATA & METHOD

For the SCM analysis, the study includes two groups and the treated unit is Japan and the intervention is the natural disaster. The control unit consists of 21 countries from OECD that showing similar characteristics with Japan in terms of employment ratio, population ratio, household disposable income, medical/non-medical determinants, etc. The pre-intervention window is between 1996 and 2010 and the post-intervention window is between 2012 and 2017.

The outcome, Y_{it}^{N}, is not exposed to the intervention at time t and unit i and the outcome, Y_{it}^{I}, is exposed to the intervention at time t and unit i. The effect of the intervention is defined by the difference between Y_{it}^{I} and Y_{it}^{N} that $\alpha_{it} = Y_{it}^{I} - Y_{it}^{N}$ in the post-intervention period.

$$W^* = \underset{W}{argmin} \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)}$$

$$V^* = \underset{V}{argmin} \left(Z_1 - Z_0 W^*(V)\right)' \left(Z_1 - Z_0 W^*(V)\right)$$

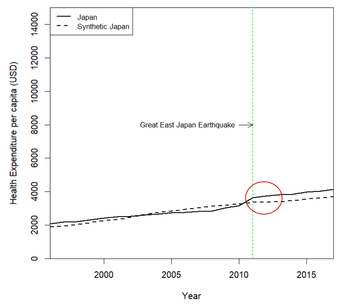
W is the weights on each control unit, and it minimizes the distance of the predictors in the pre-intervention period. V is used to find optimal predictor values, and it minimizes the distance of the outcomes of the treated and control units in the pre-intervention period.

Pre-Intervention Characteristics

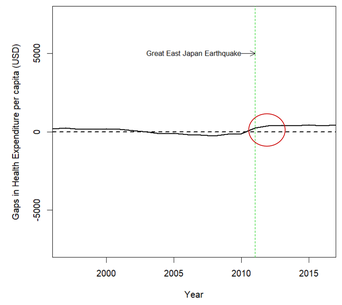
		Japan	Synthetic Japan
Health Expenditure (US$)		2597.048	2576.087
Employment ratio (%)	Agriculture	4.749	4.555
	Industry	28.380	23.587
	Service	67.045	72.369
Medical determinants	Physician density (person/1,000)	38.970	43.945
	Alcohol consumption (liter/person)	8.780	10.429
	Life expectancy (years)	80.620	77.520
Non-medical determinants	Total fat supply (grams/day)	89.571	134.436
	Total calories supply (kcal/day)	93.757	101.630
	Total protein supply (grams/day)	2847.429	3089.500
Population ratio (%)	15-64 years old population	67.675	67.166
	Over 65 years old population	17.906	12.971
HH Disposable Income (US$)		19,516	19,772

RESULTS

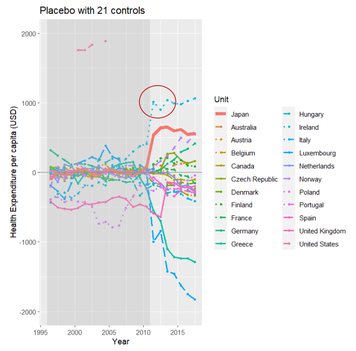
The trajectory of Health Expenditure per capita of Japan and Synthetic Japan



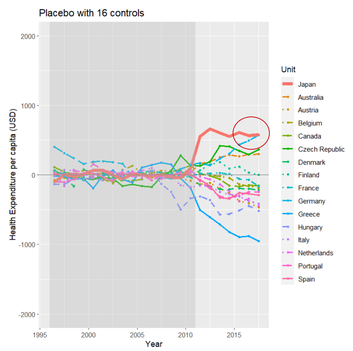
The gaps between Japan and Synthetic Japan



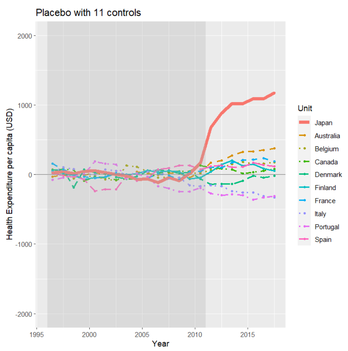
Placebo test without exclusion

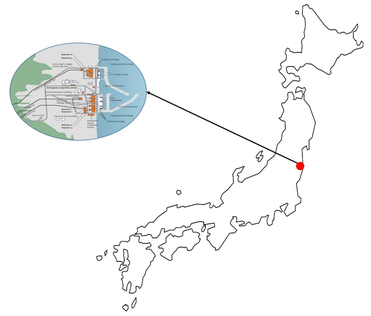


Placebo test with exclusion – 20 times

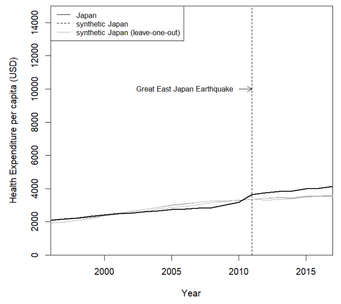


Placebo test with exclusion – 5 times





Leave-One-Out



Post- to Pre-MSPE ratio

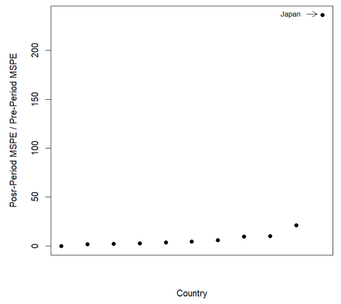
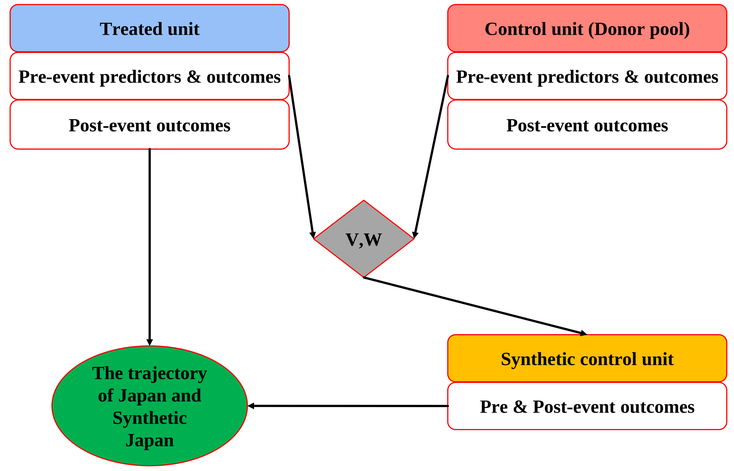


DIAGRAM OF SCM



CONCLUSIONS

The differences between synthetic Japan and Japan presents how the health expenditure per capita increases after the natural disaster. That differences imply that the effect of the natural disaster and it is the objective of the study. Placebo studies including placebo tests, leave-one-out, and Mean Square Prediction Error (MSPE) ratio show that the gaps between two units are generated by the natural disaster.

Placebo tests are developed to include proper control units in the donor pool through the exclusion of countries showing bigger MSPE than Japan. Post/Pre-MSPE ratio shows that Japan has absolutely the biggest value than the rest countries. It can be interpreted that the natural disaster affects the health expenditure in Japan.

IMPLICATION & FUTURE WORK

The SCM is useful to analyze the specific event and estimate the impact of the event. There are several implications: (1) the researchers must consider the geographical proximity; (2) the number of units in the donor pool is important; and (3) the predictors should be carefully chosen.

For example, the SCM analysis shows insignificant estimates while performing the method within Japan. The intervention brings about the secondary event which is the spread of radioactive material from the meltdown of nuclear reactors. That could contaminate the data of local towns/villages in the donor pool.

REFERENCE

Abadie, A. and Gardeazabal, J., 2003. "The Economic Costs of Conflict: A Case Study of the Basque County." *The American Economic Review*, Vol. 93, No. 1, pp. 113-132.

Ando, M., 2015. "Dreams of urbanization: Quantitative case studies on the local impacts of nuclear power facilities using the synthetic control method." *Journal of Urban Economics*. Vol. 85, pp. 68-85.