Causality between built environment and subjective wellbeing:
Integrated application of statistical and machine learning methods

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Introduction

- Integrating difference-in-differences[1] and synthetic controls ensemble[2] with causal forest[3].
- UK Household Longitudinal Survey 2009-19: 11 years of balanced panel data (N=5,392).
- Household relocations as natural experiments – spatial granularity at Census LSOA level.
- Quantify heterogeneous causal effect of relocation on subjective wellbeing (GHQ-12).
- Lower GHQ-12 score corresponds to lower distress and higher subjective wellbeing.

Results and Discussion

- Immediate and enduring improvement to wellbeing (8 - 15%) following relocation.
- Relocation distress is transitory.
- Individual (latent lifestyle) and neighbourhood level covariates.
- Change in built environment is a positive causal factor (Model 2).
- Without change in built environment, the causal effects become insignificant (Model 3).
- Cross-validated model results using causal machine learning.

Table 1. Summary of statistical ensemble – 3 comparative models.

Causal Model	Model 1: All Relocations		Model 2: Change in Built Environment		Model 3: No Change in Built Environment	
	Treated: 773 Control: 4,619		Treated: 506 Control: 4,619		Treated: 267 Control: 4,619	
T =	DiD	SCM	DiD	SCM	DiD	SCM
-3	0.496 **	-0.101	0.336 *	-0.020	0.327	-0.242
-2	-0.003	0.137	-0.098	0.161	-0.120	0.094
-1	0.469 ***	-0.089	0.463 **	-0.181	0.105	0.070
0	-0.635 ***	0.023	-0.437 **	0.066	-0.262	-0.052
1	-0.708 ***	-0.598 **	-0.501 ***	-1.008 ***	-0.184	0.114
2	-0.915 ***	-0.896 *	-0.591 ***	-1.470 ***	-0.518	0.100
3	-0.762 ***	-1.262 **	-0.668 ***	-2.053 ***	0.018	0.112
4	-0.863 ***	-1.230 *	-0.395 *	-2.308 **	-0.265	0.641
5	-0.984 ***	-1.157	-0.675 ***	-2.549 *	-0.034	1.318
Weighted Average	-0.808 ***	-0.991 *	-0.544 ***	-1.963 *	-0.208	0.697
Ensemble ATE	-0.899		-1.243		0.245	

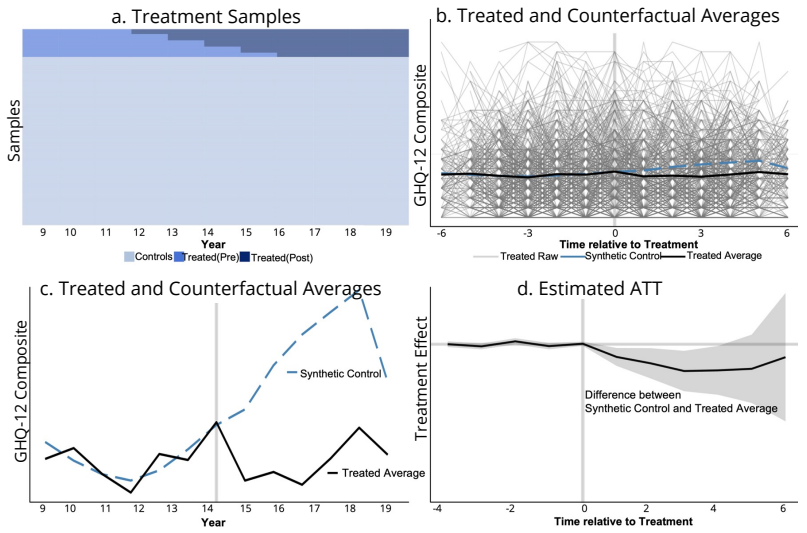

Figure 1. Treatment effects of relocation comparing synthetic control to observed treated average.

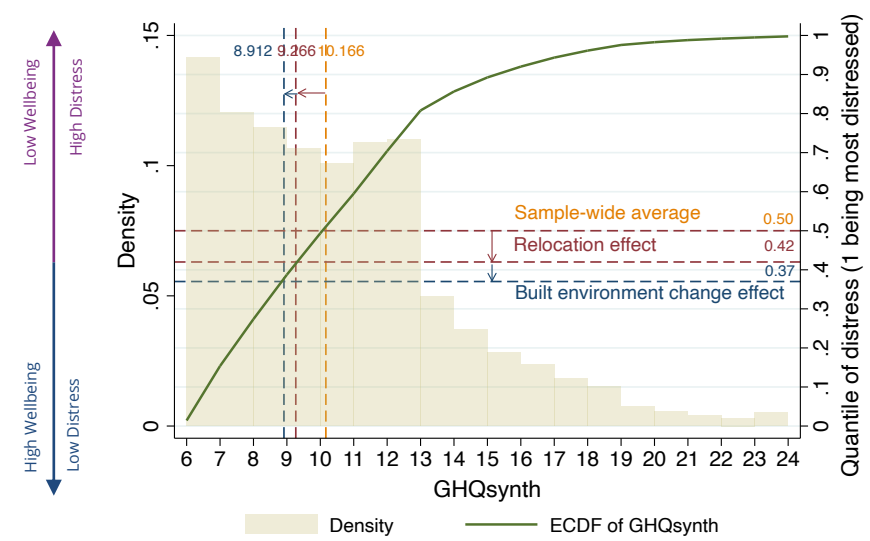

Figure 2. Contextualising wellbeing effects of relocation and built environment change.

Conclusion

- Relocation decision linked to sense of control and coping.
- Changing built environment shifts dynamic equilibrium of wellbeing, offsetting relocation uncertainties.
- More research on relocation motivations required.

Based on paper accepted at International Conference on Machine Learning 2023
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References

[1] Callaway, B., & Sant'Anna, P. H. C. (2021). Difference-in-Differences with multiple time periods.
[2] Abadie, A., Diamond, A., & Hainmueller, J. (2015). Comparative Politics and the Synthetic Control Method.
[3] Athey, S., & Imbens, G. (2016). Recursive partitioning for heterogeneous causal effects.

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