Redistribution of Patients, Medical Resource Utilization, and Quality of Care after Hospital Closure

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INTRODUCTION & BACKGROUND

The study examines the broader impacts of 8 hospital closures on 3 major outcomes from 2010-2020 in Georgia: Patient redistribution, Medical resource utilization, and Quality of care

Major limitations in the literature that lead to inconsistent findings:

- Not sufficiently separating the Heterogeneous treatment effect
- Lack of robust causal inference framework (given small number of treated units and heterogeneous treatment timing)
- Lack of rigorous treatment assignment for treated hospitals

METHODOLOGY

Impact evaluation under the synthetic Diff-in-Diff framework: Construct counterfactual trend by:

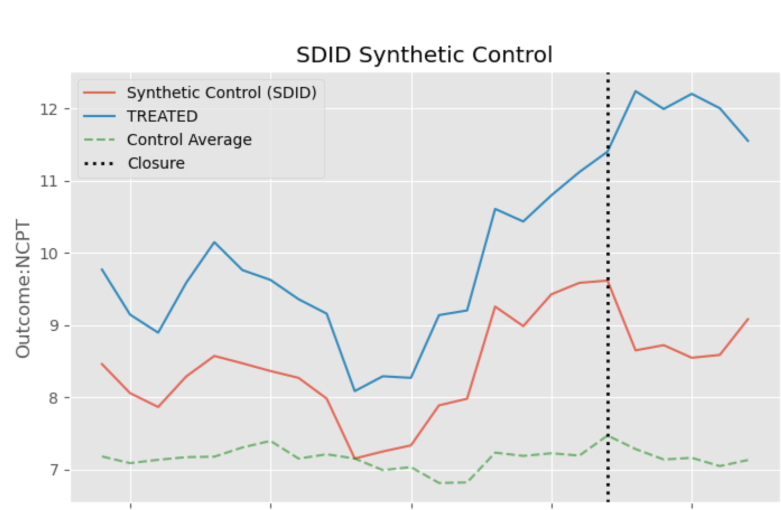
$$\hat{\lambda}^{sdid} = \underset{\lambda}{\operatorname{argmin}} \, ||\bar{\boldsymbol{y}}_{post,co} - (\boldsymbol{\lambda}_{pre}\boldsymbol{Y}_{pre,co} + \lambda_0)||_2^2$$

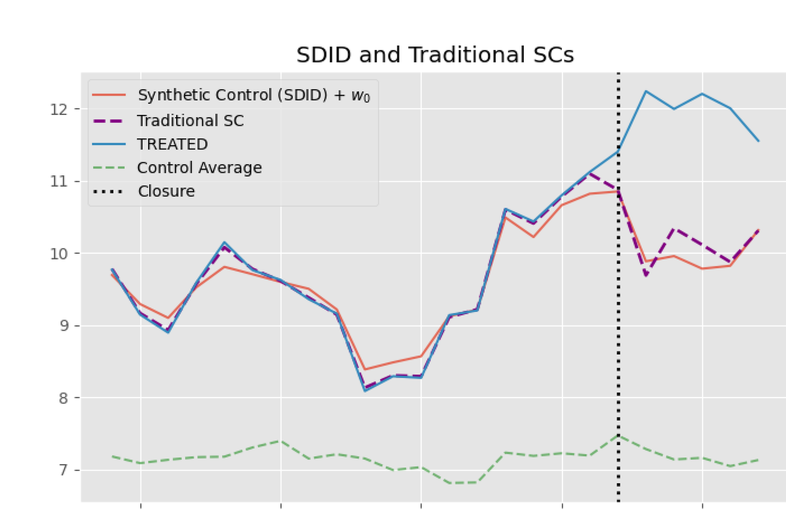
$$\text{s.t} \sum \lambda_t = 1 \text{ and } \lambda_t > 0 \, \forall \, t$$

$$\hat{w}^{sdid} = \underset{w}{\operatorname{argmin}} \, ||\bar{\boldsymbol{y}}_{pre,tr} - (\boldsymbol{Y}_{pre,co}\boldsymbol{w}_{co} + w_0)||_2^2 + \zeta^2 T_{pre}||\boldsymbol{w}_{co}||_2^2$$

$$\text{s.t} \sum w_i = 1 \text{ and } w_i > 0 \, \forall \, i$$

$$\hat{\tau}^{sdid} = \underset{\mu,\alpha,\beta,\tau}{argmin} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - (\mu + \alpha_i + \beta_t + \tau D_{it}))^2 \hat{w}_i^{sdid} \hat{\lambda}_t^{sdid} \right\}$$

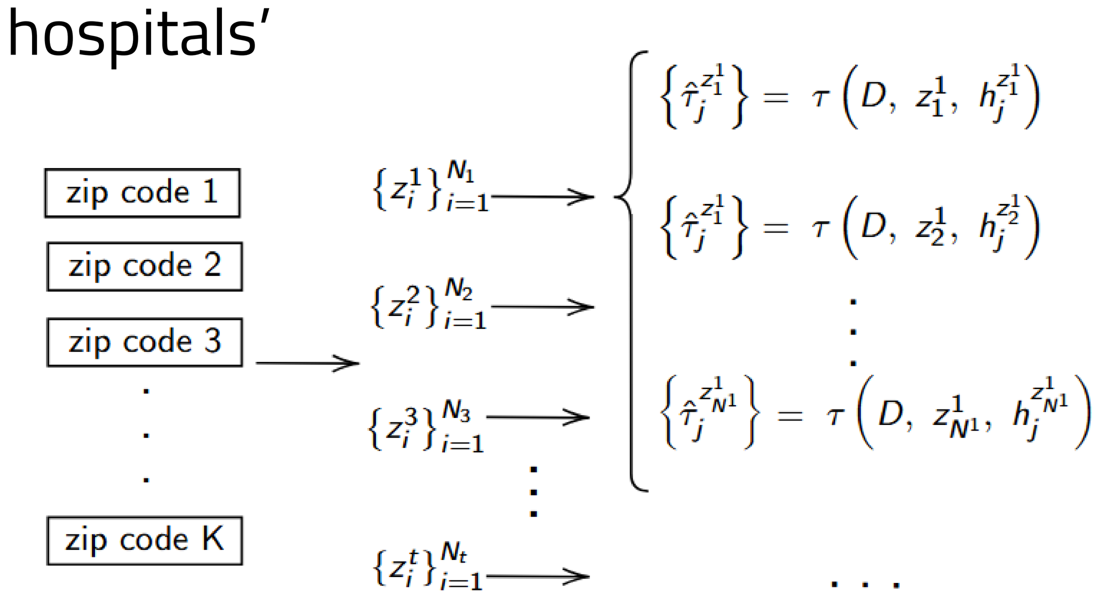




Treated hospital Identification:

- Translate the task: Identify affected adjacent hospital -> identify patient's alternative hospital based on post-closure preference

Strategy for revealing preference: test patient influx from every 'affected region' to every potential 'alternative hospitals'



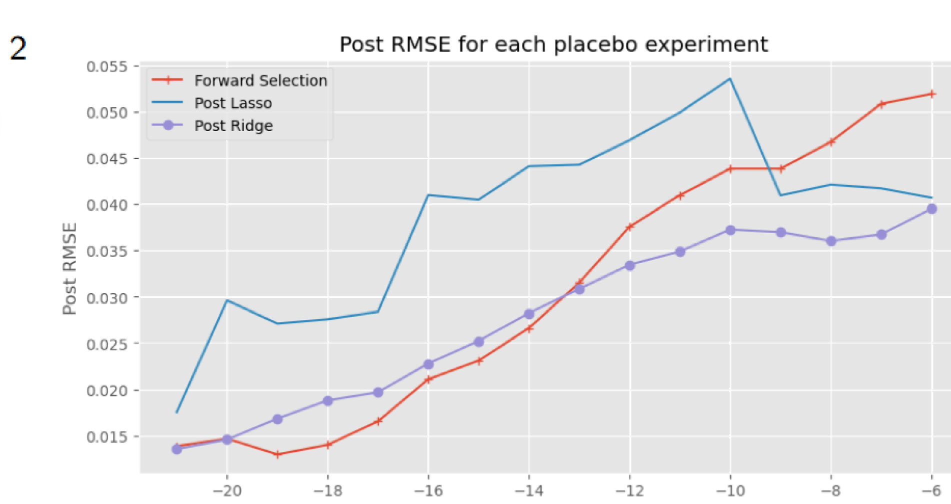
Placebo variance estimation and stacked estimates

- Traditional robust standard error would be biased with a small number of treated units
- Placebo estimates: resample treated units from the donor pool without replacement

$$\hat{V}_{\tau}^{placebo} = \frac{1}{B}\sum_{b=1}^{B}\left(\hat{\tau}^{(b)} - \frac{1}{B}\sum_{b=1}^{B}\hat{\tau}^{(b)}\right)^2$$

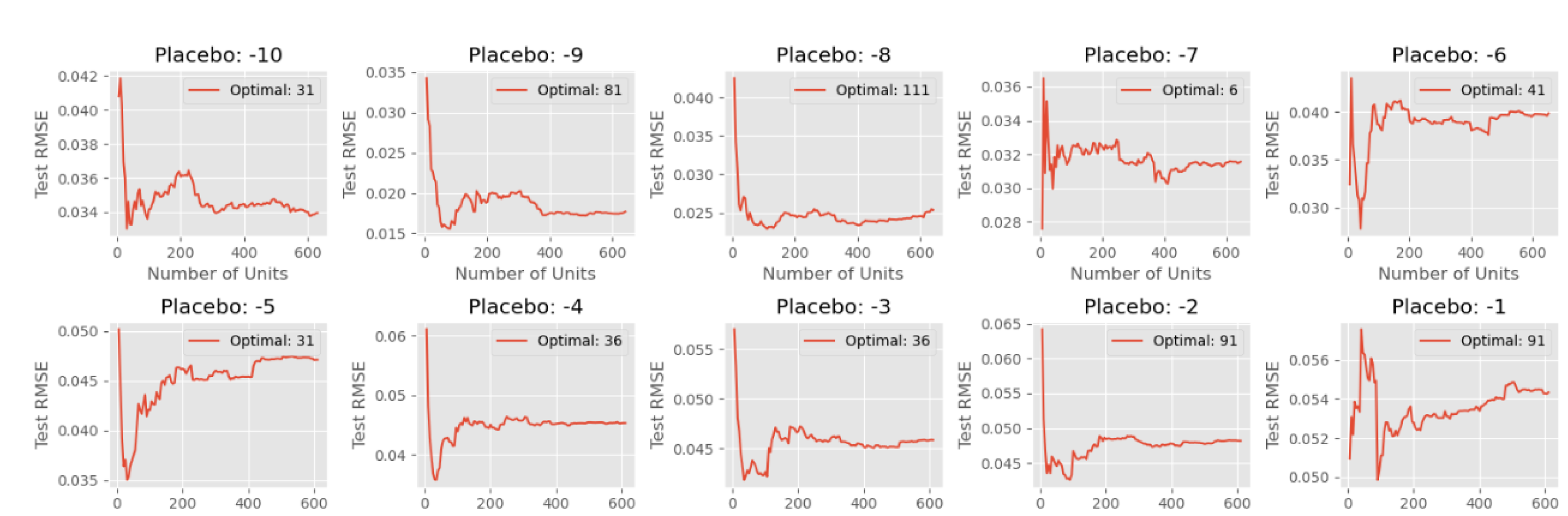
$$\tau \in \hat{\tau}^{sdid} \pm z_{\alpha/2}\sqrt{\hat{V}_{\tau}^{placebo}}$$

$$\hat{\tau} = \sum_{l}(\mu_l \cdot \hat{\tau}_l) \qquad \mu_l = \frac{N_l}{\sum_l^L N_l}$$

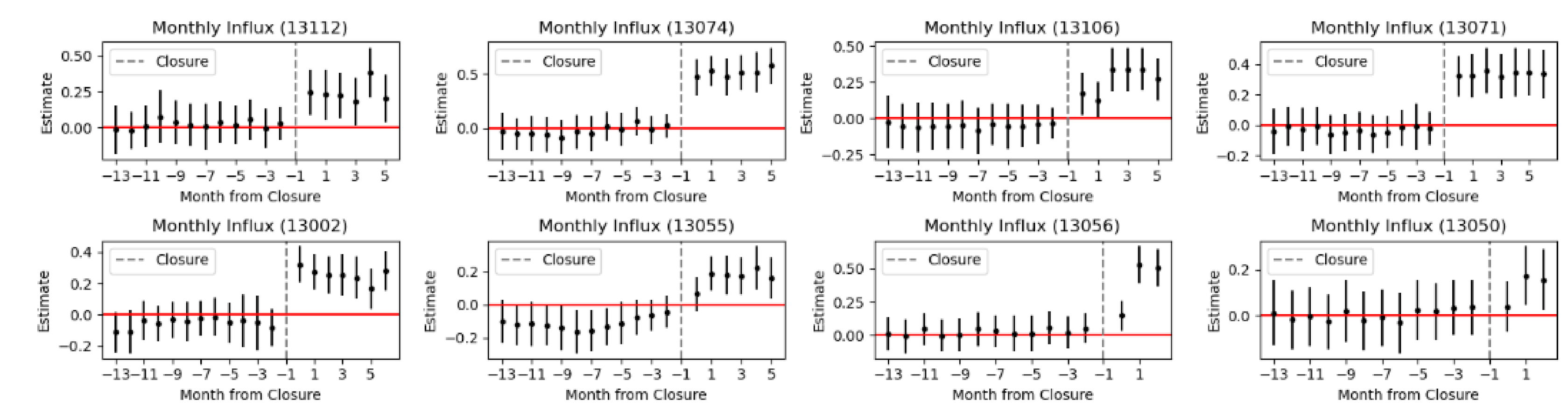


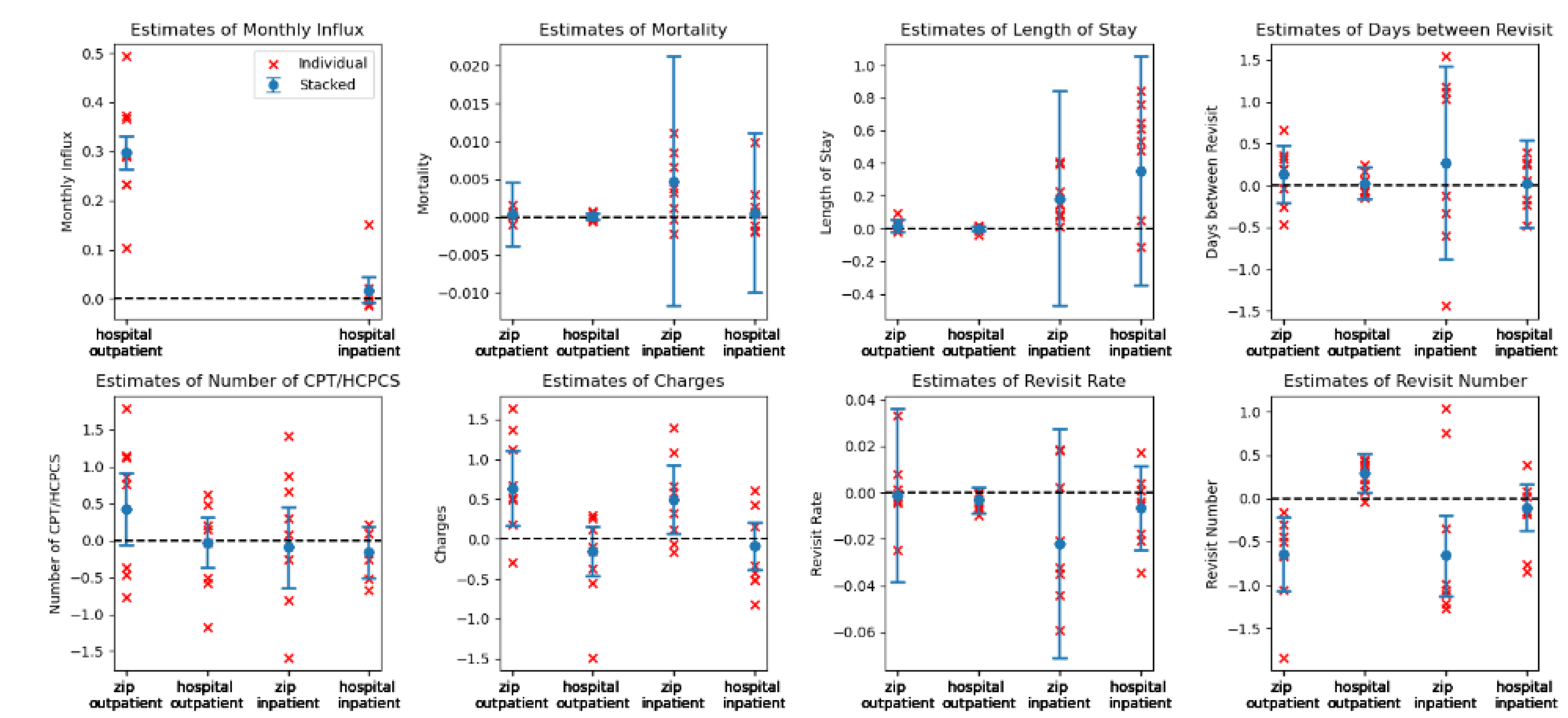
Donor pool selection: Problem of overfitting: T << N

- Forward Selection to trim the donor pool
- Start with 0 donors, add one donor that brings the best fit at each step, and select the optimal number of donors that minimize the test errors
- First-stage Ridge Forward Selection method: less computationally burdensome without much loss of predictive power



MAJOR RESULTS&FINDINGS





- Significant patient redistribution for outpatient care
- Total charges per patient per admission increased
- No significant negative effects on quality of care
- More rural closures had more severe impacts on access, costs, and quality than less rural closures
- Regional effects were larger than hospital-level effects indicating broader societal impact of closures
- Survival bias inherent in hospital-based datasets
- Validity of revisit/readmission related outcomes

$$\frac{dP(R)}{dC} = \frac{\partial P(R)}{\partial E}\frac{dE}{dC} + \frac{\partial P(R)}{\partial A}\frac{dA}{dC}$$