School Competition and Classroom Segregation

Angela Crema

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Motivation

- Competition in education markets: "a tide that lifts all boats" (Hoxby, 2003)
  - Promise extends to minority students in TPS: charter schools tend to locate in disadvantaged areas (Singleton, 2019)
- Implicit assumption: households solely value school characteristics that raise their children's test scores
- Evidence that share of white peers drives schools choice (Abdulkadiroglu et al., 2021; Hastings et al., 2009)
- TPS will racially segregate students across classrooms, which disproportionately harms non-whites

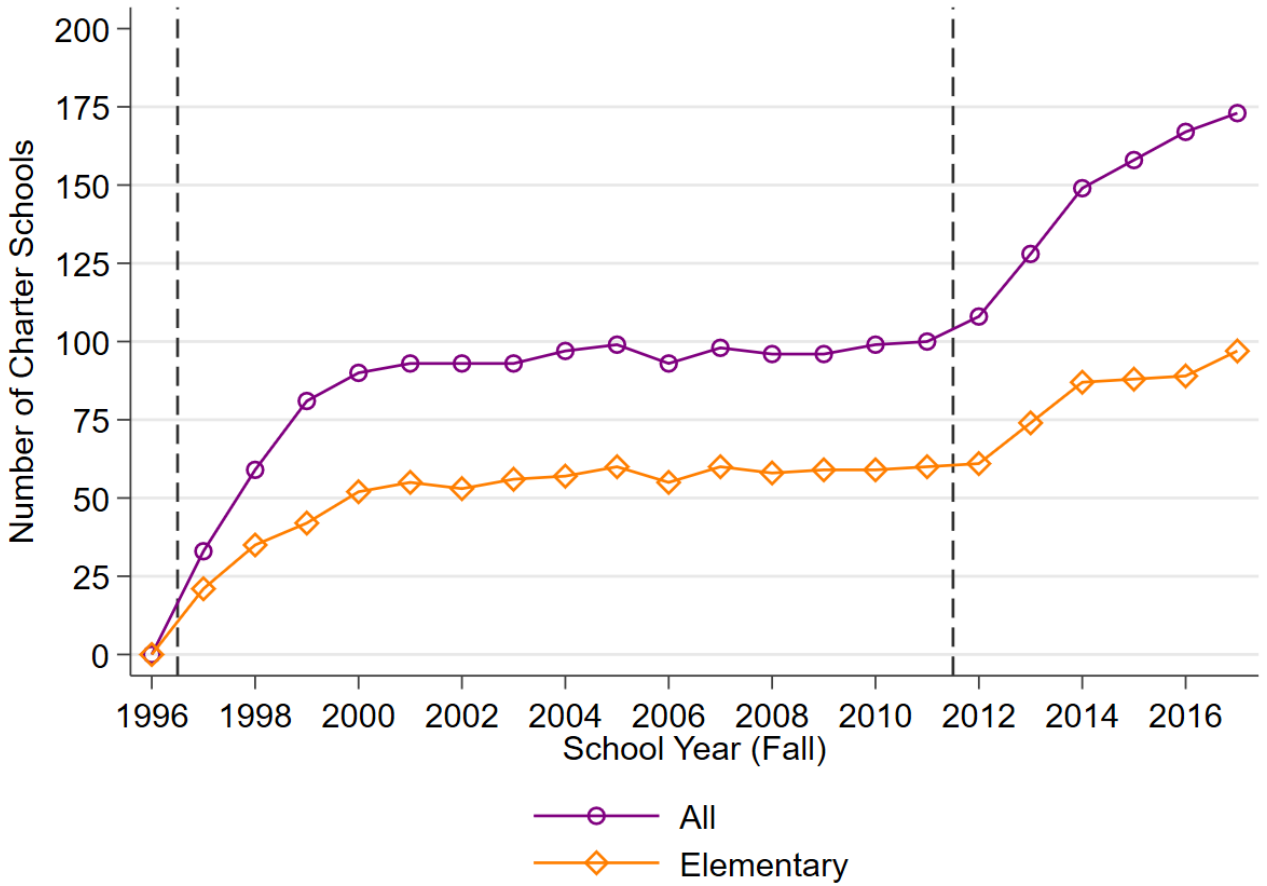
This Paper

- What is the effect of charter openings on racial segregation across classrooms at Traditional Public Schools (TPS)?
- Exploit almost 100 charter openings in North Carolina from 1997 to 2015 to compare classroom segregation in nearby TPS to those further away, pre- and post-opening
- Combine charter school openings with data on within-school segregation across classrooms from North Carolina Education Research Data Center (NCERDC)

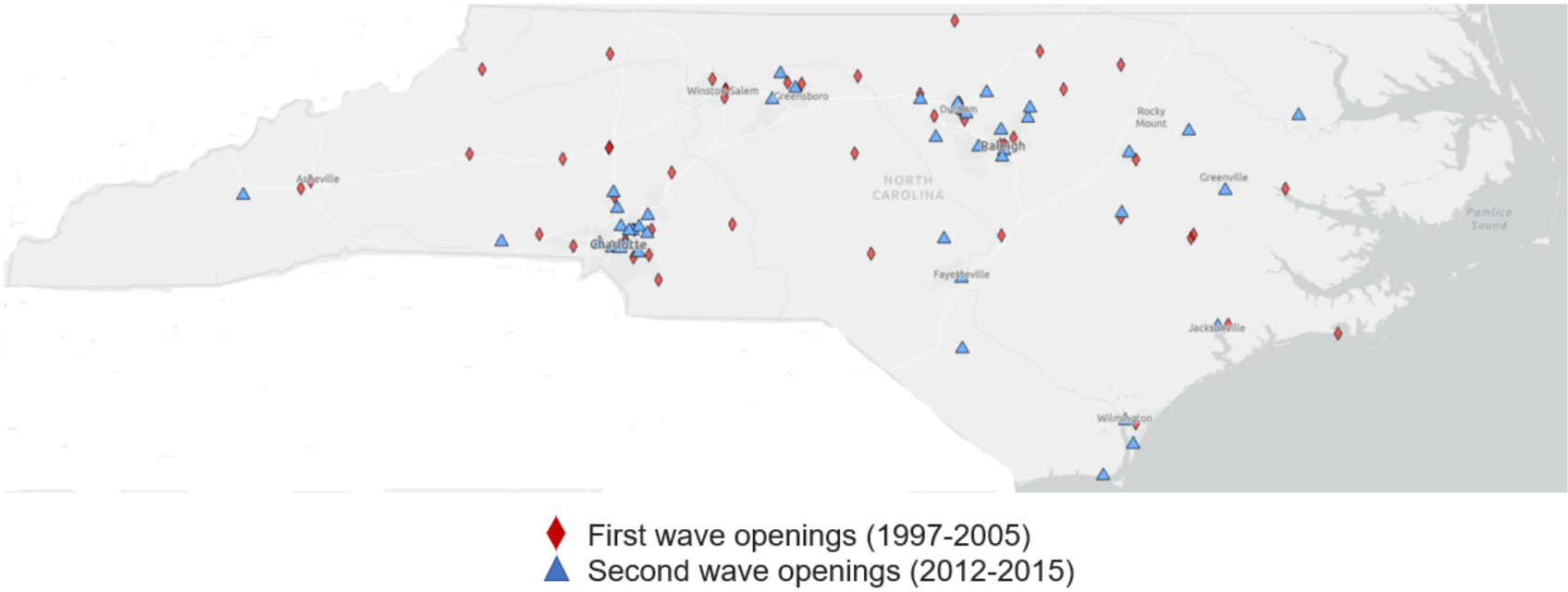
Result Preview

- Charter opening increases TPS classroom segregation significantly
- Increase occurs upon opening *announcement*
- No significant change in ability segregation (conditional on race), teacher value-added, or class size
- Fraction of white TPS students with Gifted and Talented status rises at expense of non-whites
- Racial test score gap increases by 10%

NC Charter Sector Has Been Growing Rapidly



Concentrated In Urban Areas

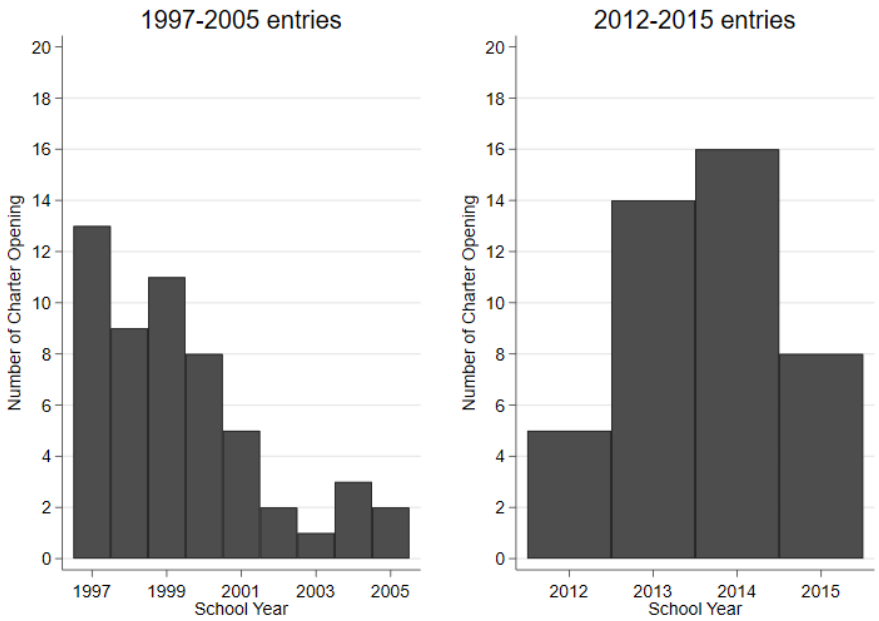


TPS Fear White-Skimming From Charter Schools

- Charter schools in NC successfully "white-skim" from neighborhoods
  - School decisions: location, curriculum, required parental involvement, advertising, ...
  - State legislature: charters allowed to forego free transportation, meals, and after school programs
- TPS school leaders have firmly and openly opposed charter expansion in NC

Treated And Control Schools

- Sample: TPS that experience at least one charter opening within 10 miles between 1997 and 2015
- TPS s treated in year y if closer than 5 miles to year y charter opening, control otherwise
  - Schools compete spatially due to parents' distaste for distance



Event Study

- Estimate

$$D_{st} = \alpha + \sum_{k=-3}^{-2} \beta_k 1[\tau_t = k] 1[treated_s = 1] + \sum_{k=0}^{+2} \gamma_k 1[\tau_t = k] 1[treated_s = 1] + \delta X_{st} + \phi_s + \phi_t + \epsilon_{st} \quad (1)$$

  - D index of dissimilarity (white-nonwhite) for Math index
  - τ time relative to charter opening
  - X school size and share of white students
  - ϕ_s school fixed effects; ϕ_t year fixed effects

- Deal with heterogeneous timing of treatment Method

Racial Segregation Increases Upon Charter Opening

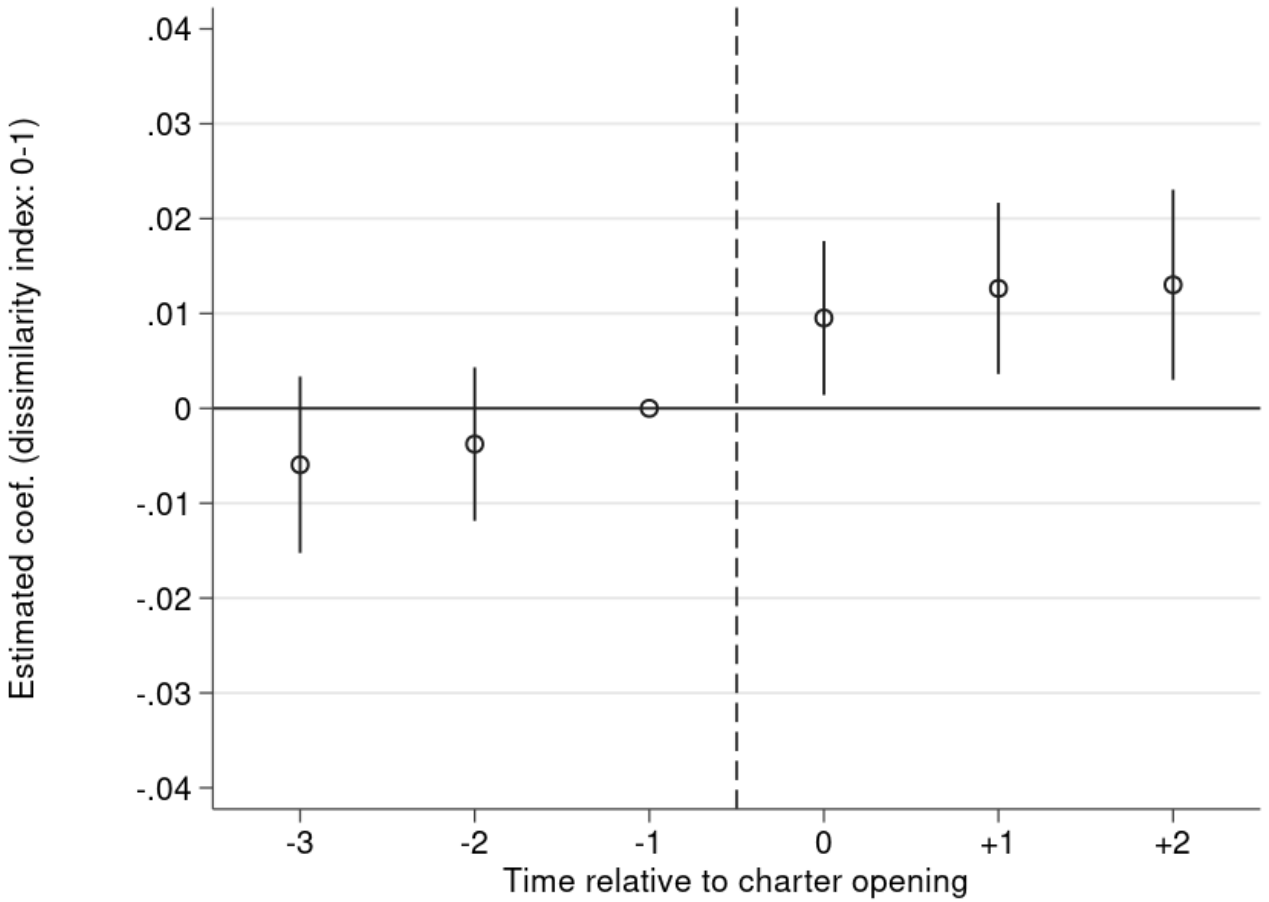
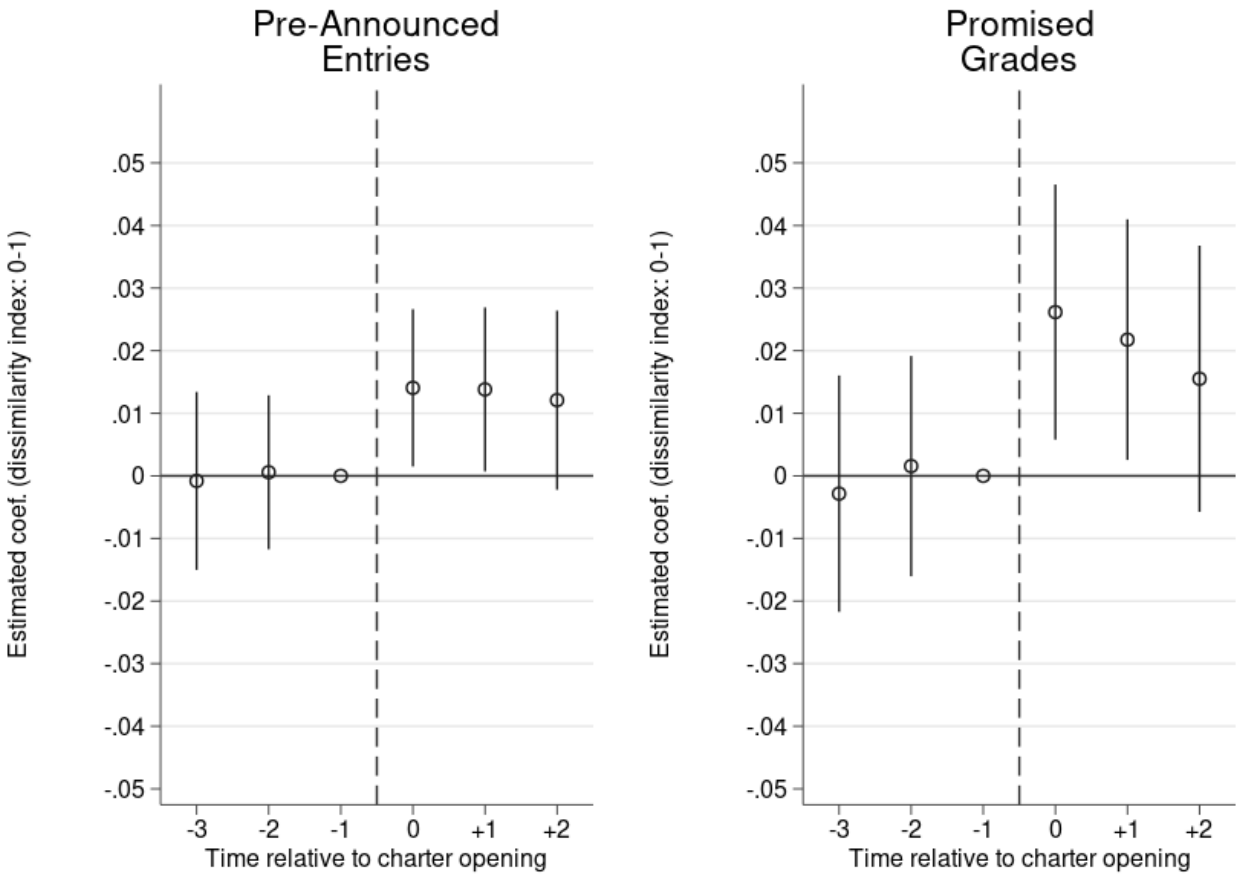


Table ELA

Result Is

- Not driven by change in student body composition
  - Pre-announced entries (Figlio and Hart, 2014; Gilraine et al., 2021)
  - Grades that entrants commit to open in near future
- Not dependent on treatment threshold
  - Robust to specification with continuous distance See
- Robust to dissimilarity index corrected for small unit bias See
- Robust to $log\left(\frac{D}{1-D}\right)$ transformation of dependent variable See

Segregation Increases Upon Opening Announcement



Result Is

- Larger in urban areas See
- Larger in non-white areas See
- Larger at desegregated TPS See

No Evidence That Other Inputs Are Reallocated

- High-ability peers (conditional on race) Measure Results
- Teacher value-added VA estimation Results
- Class size Results
- Share of white students with Gifted and Talented status increases by 6% Results Event Study

Test Score Inequality Widens Upon Charter Entry

VARIABLES	(1) P90-P10	(2) Racial Gap
Within 5 miles × Post	0.057**	0.050***
	(0.026)	(0.018)
Size	Y	Y
% White	Y	Y
School FE	Y	Y
Year FE	Y	Y
Observations	3,588	3,588
R-squared	0.454	0.678
Mean dep. var.	2.328	0.491

Conclusions

- Exploit almost 100 charter openings in North Carolina and rich student-level administrative data
- Show that charter entry significantly increases classroom segregation by race at TPS nearby
- Provide suggestive evidence that TPS respond to competition by optimally embedding white households' preferences and segregating white students
- This response leaves non-white students behind
- Future work: what if gifted programs / tracking are banned?

Thank you!

For comments or questions, please email me at:
ac7335@nyu.edu

Dealing With Heterogeneous Timing Of Treatment

- Under treatment effect heterogeneity, event study estimate for one relative-time period is contaminated by causal effects of other periods (Abraham and Sun, 2021)
- Mechanically ensure that no previously-treated units enter as controls (Cenzig et al., 2019)
  - For each treatment cohort C_c, get all treated units, plus all units not treated by year $c + 2$
  - For each cohort-specific data set, keep only observations from year $c - 3$ to $c + 2$
  - Stack cohort-specific data sets in relative time
  - Run standard specification with interactions between cohort identifier and fixed effects, controls, clusters

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Measure Cross-Classroom Racial Segregation

- Compute racial segregation by **s**chool-**g**rade-**c**ourse-**t**ime as

$$D_{sgct} = \frac{1}{2} \sum_{d} \left| \frac{w_{sgctd}}{W_{sgct}} - \frac{nw_{sgctd}}{NW_{sgct}} \right| \tag{2}$$

with d course section (division); w and nw (W and NW) number of white and non-white students enrolled by section (course)

  - $D = 0$ (1) means that no (all) non-white students should change section to obtain even distribution within course (Duncan and Duncan, 1955)

- Compute D_{sy} averaging across courses within grade, and then across grades

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Classroom Segregation Increases Upon Charter Entry

VARIABLES	(1) All entries	(2) 1997-2005 entries	(3) 2012-2015 entries
Within 5 miles × Post	0.015***	0.017***	0.012**
	(0.004)	(0.005)	(0.005)
School size	Y	Y	Y
School white share	Y	Y	Y
School-by-cohort FE	Y	Y	Y
Year-by-cohort FE	Y	Y	Y
Observations	23,622	18,096	5,526
R-squared	0.790	0.802	0.731
Mean dependent variable pre-entry	0.204	0.198	0.224

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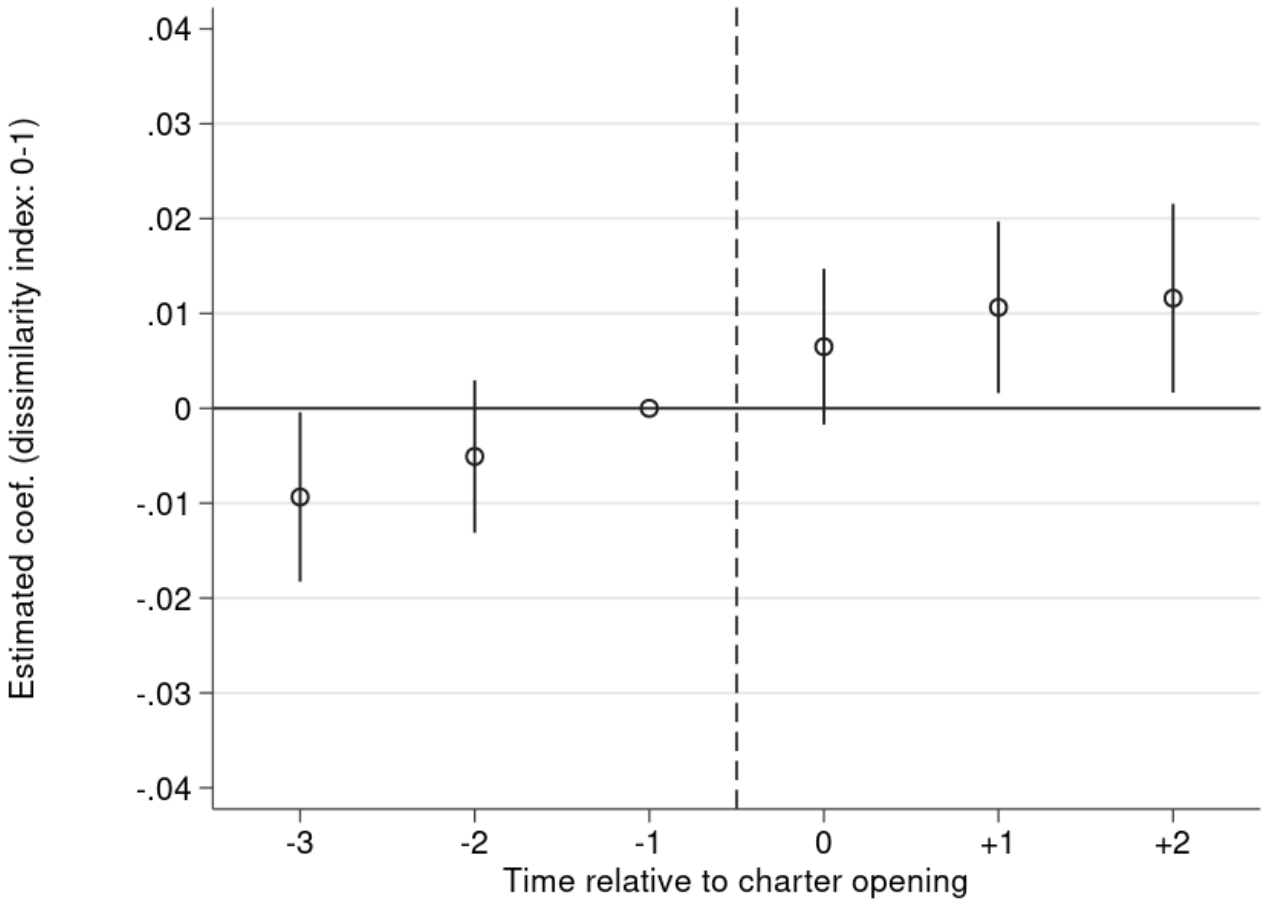
Classroom Segregation Increases Upon Charter Entry



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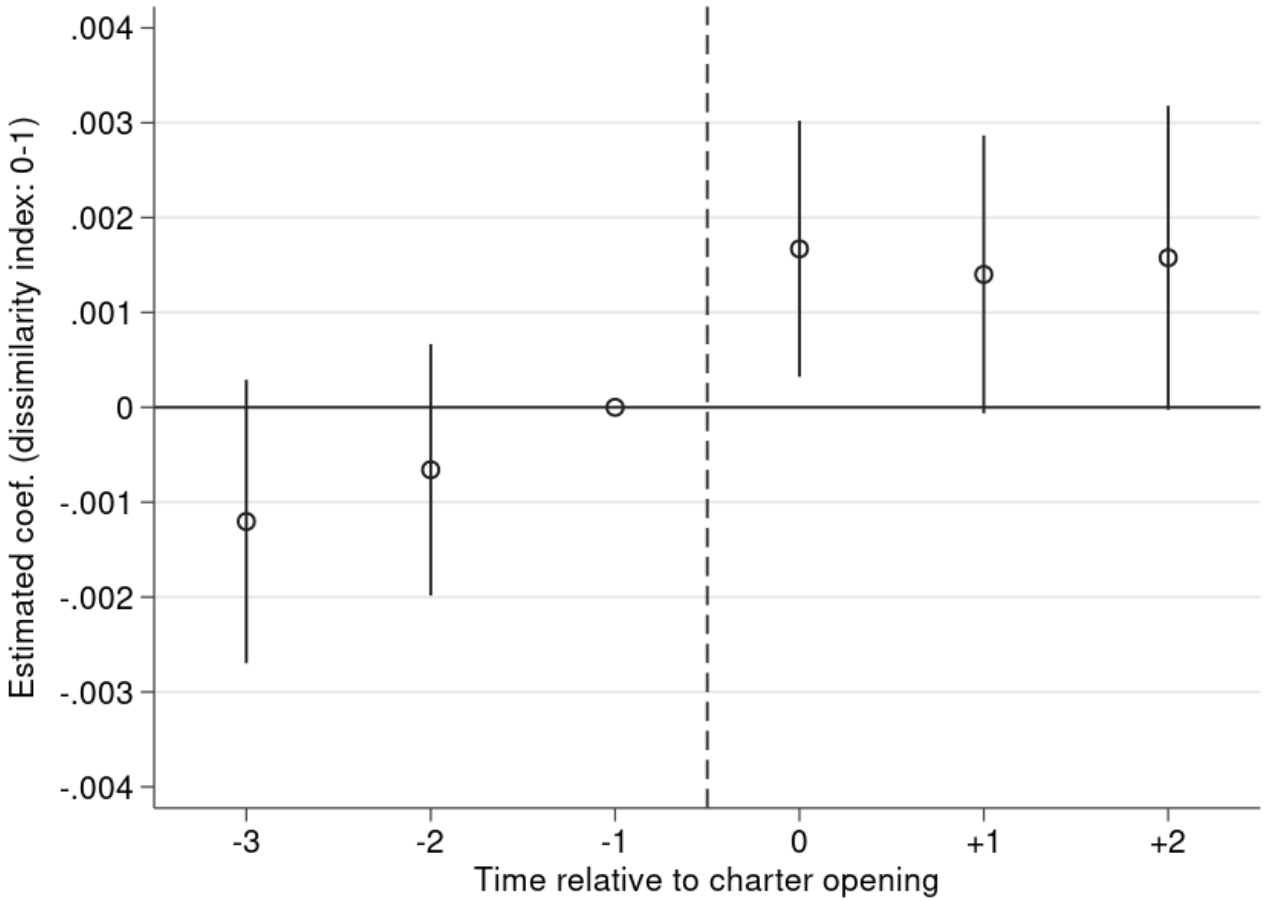
Main Result Not Dependent On Treatment Threshold



Indicators for time to charter opening are interacted with continuous measure of treatment $\tilde{d} = 15 - d$, d being TPS-charter physical distance. $\tilde{d}$ can range from 0 (no entry within 15 miles) to 15 (charter and TPS locations overlap). Sample is restricted to TPS that experience entry closer than 15 miles over time window.

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Dealing With Small Unit Bias

- Problem: when units contain few individuals, indices based on minority shares in units are upward biased
- Two main approaches:
  1. Correct naive indices subtracting measure of bias (Cortese et al., 1976; Carrington and Troske, 1997; Allen et al., 2015)
  2. Use inequality index based on distribution of unobserved probabilities (parametric: Rathelot, 2012; non-parametric: D'Haultfoeuille and Rathelot, 2017)
- Use first approach to maintain sufficient variability in index

Dealing With Small Unit Bias (Cont'd)

- Follow approach proposed by Carrington and Troske (1997)
- Define D^* expected dissimilarity index implied by random allocation of population with minority share p to n units, each of size s

$$\lim_{n\to\infty} D^*(s,p,n) = \sum_{m=0}^{s} \frac{1}{2} B(m;s,p) \left| \frac{(s-m)}{s(1-p)} - \frac{m}{sp} \right| \qquad (3)$$

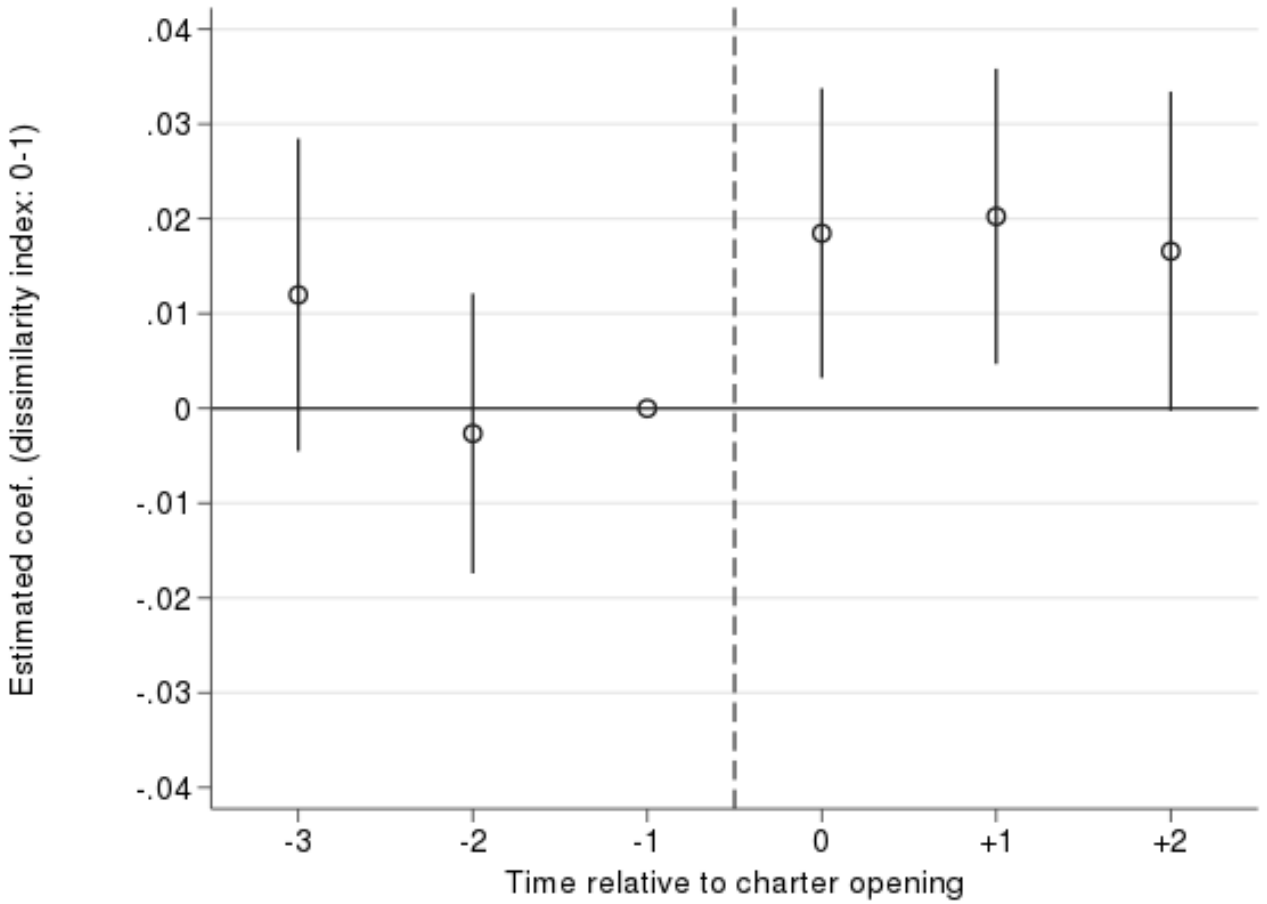
with B binomial density function

Dealing With Small Unit Bias (Cont'd)

$$\hat{D} = \begin{cases} \frac{D-D^*}{1-D^*} & D \geq D^* \\ \frac{D-D^*}{D^*} & D < D^* \end{cases} \tag{4}$$

- Varies from -1 (maximum evenness) to 1 (maximum unevenness); 0 means that the sample is equivalent to random allocation

Main Result Robust To Small Unit Bias Concerns



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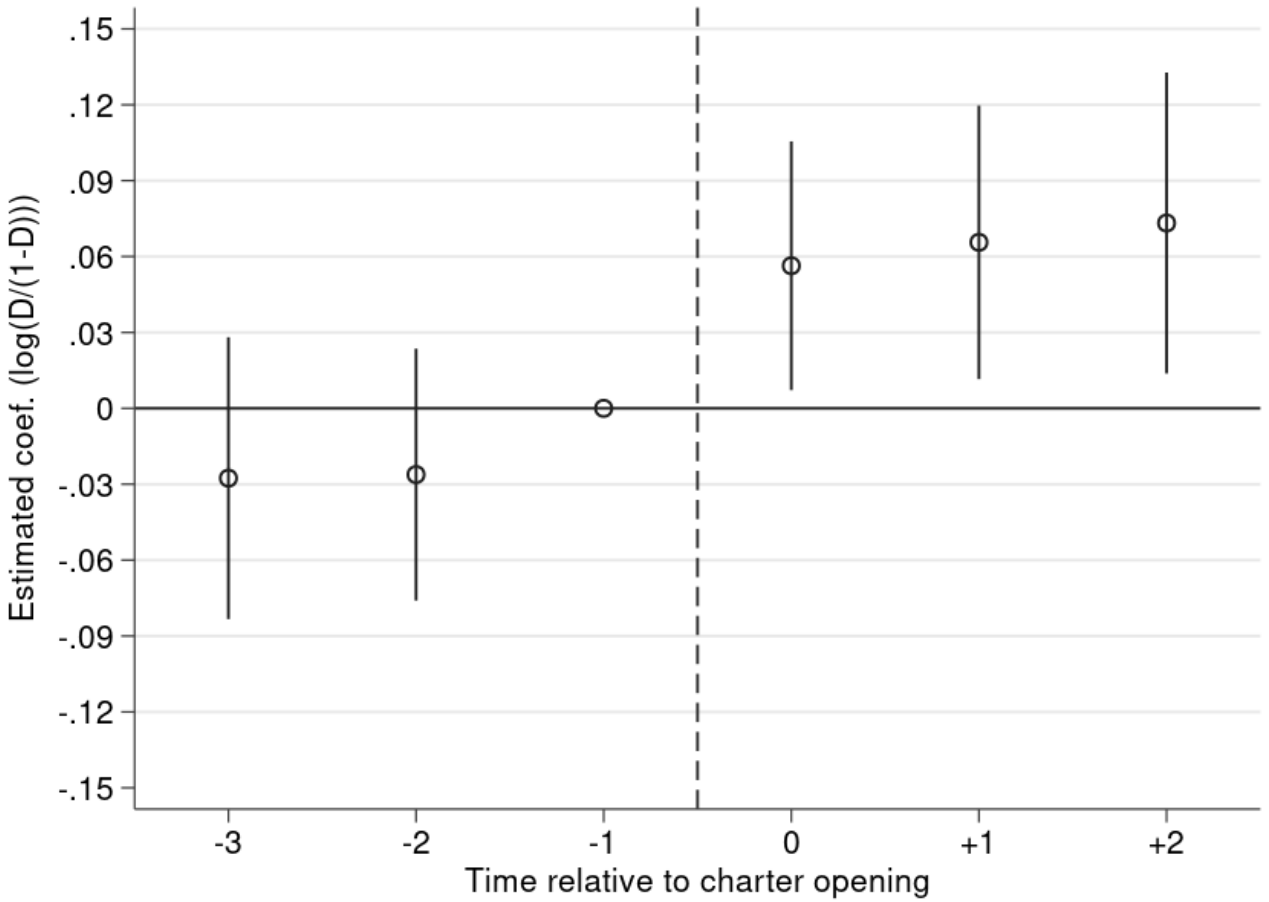
Result Not Driven By Misspecification



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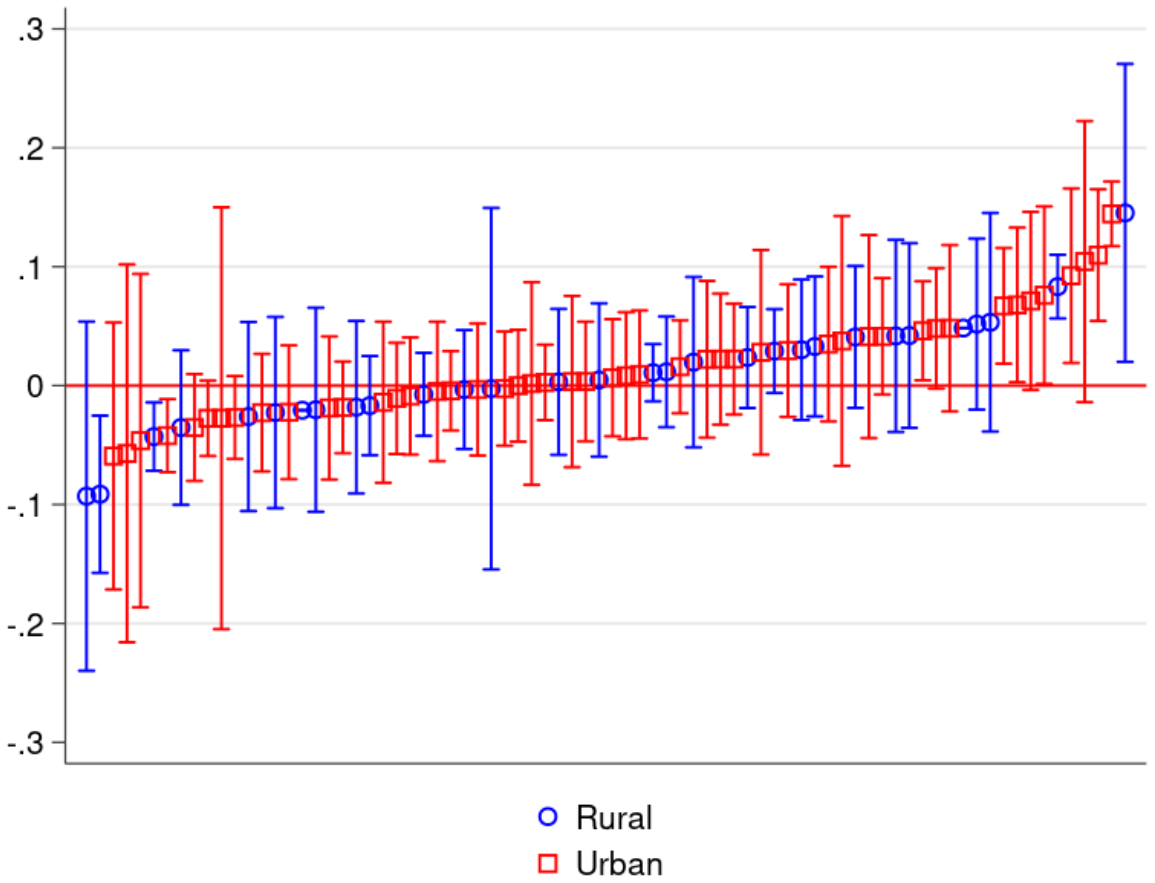
Treatment Effect Rather Constant



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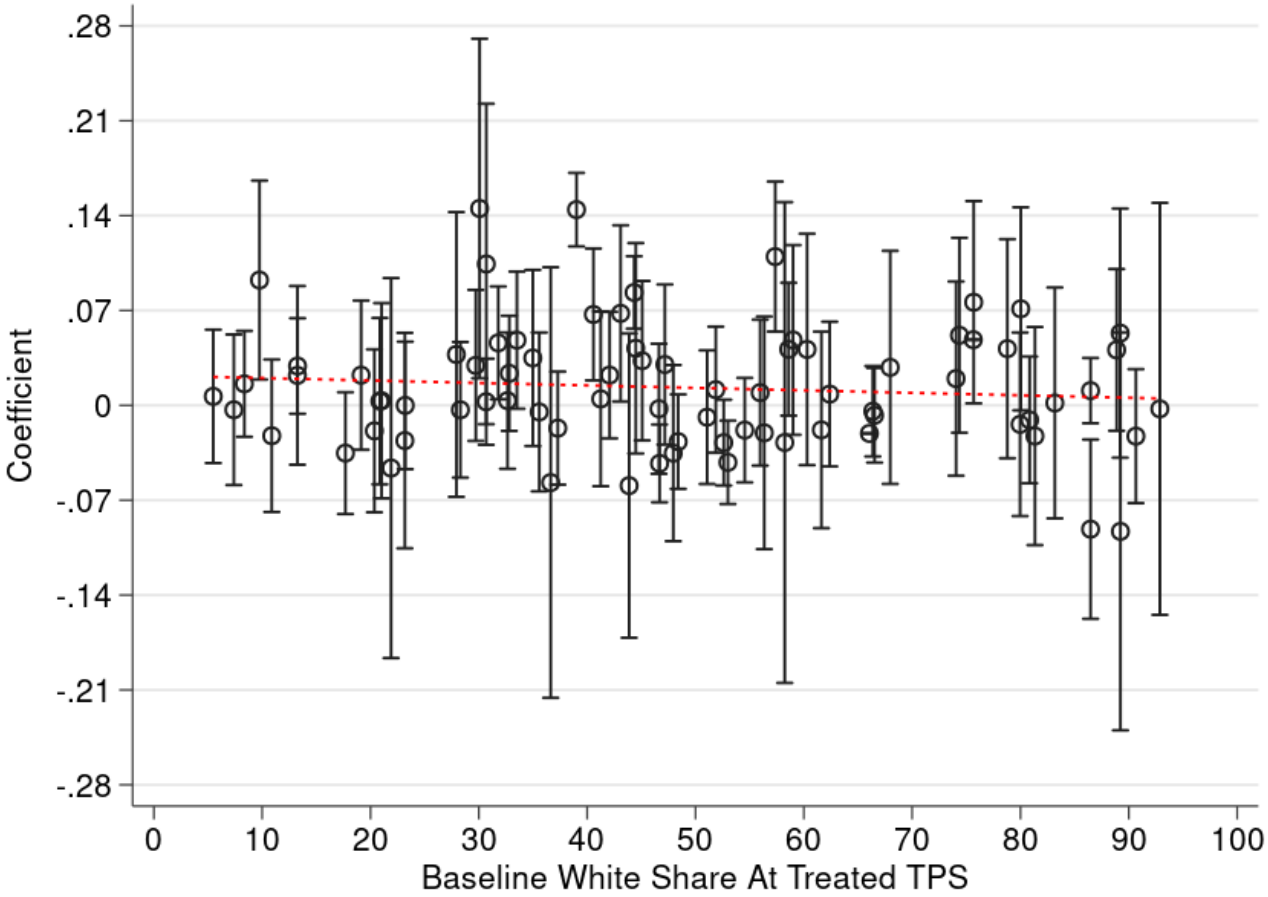
Treatment Effect Larger In Non-White Areas



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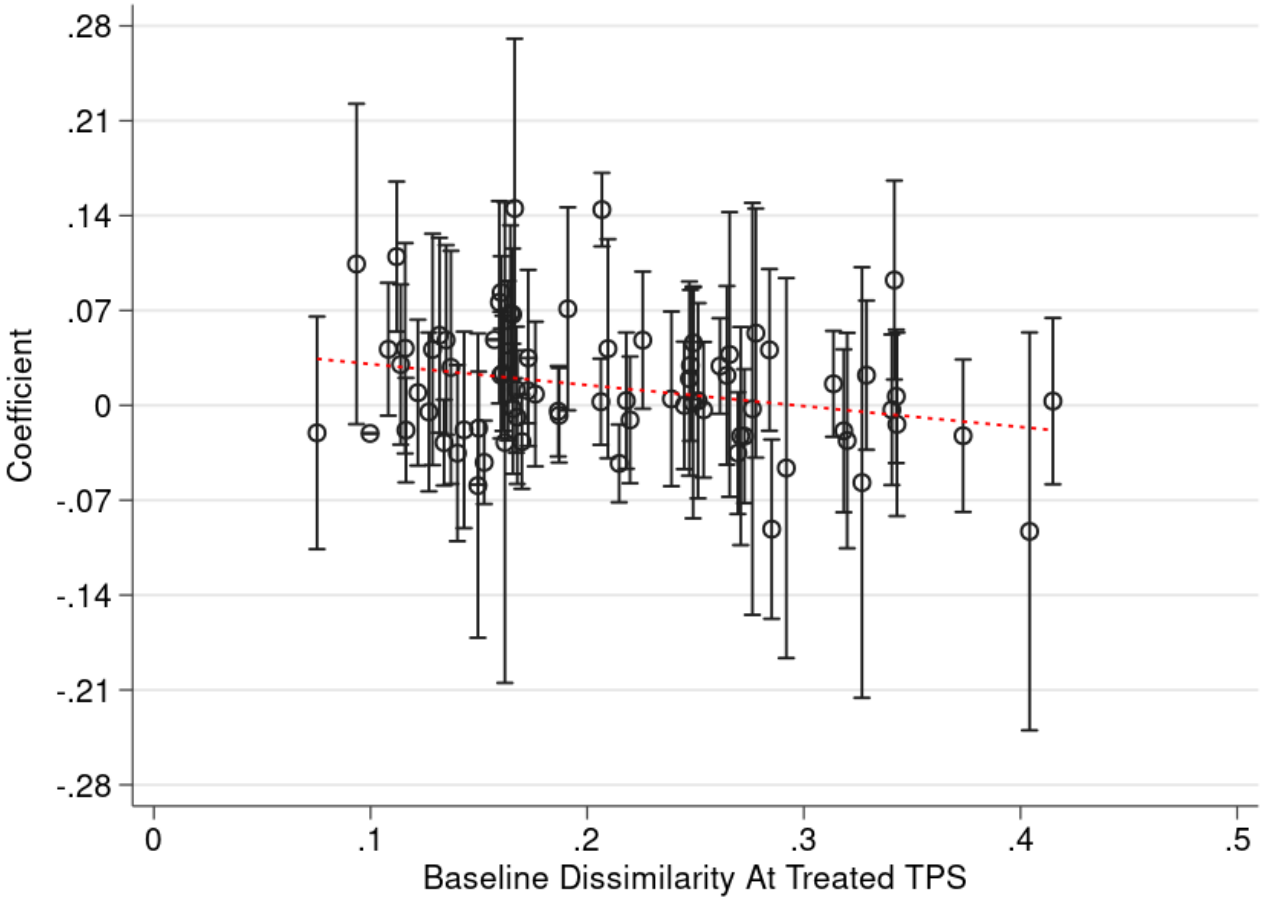
Treatment Effect Larger At Desegregated Schools



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Ordinal Information Theory Index

$$I = \sum_{m=1}^{M} \frac{t_m}{T\nu}(\nu - \nu_m) \tag{5}$$

- m denotes section
- t_m is number of students in section m
- T is number of students in course
- $$\nu = \frac{1}{K-1} \sum_{j=1}^{K-1} -[c_j log_2 c_j + (1-c_j) log_2 (1-c_j)] \tag{6}$$
- K number of ordered categories (quartiles)
- c_k cumulative proportion of students in decile k or lower

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Value Added Estimation

- Estimate value added for each (Math) teacher using Parametric Empirical Bayes estimator
- Import estimates into student panel via teacher identifier
- Define student i treated (control) in year y if she attends a treated (control) TPS in year y
- Estimate student-level event study specification with school FE and average value added by (i, y) as outcome variable

Value Added Estimation (Cont'd)

- Test scores given by

$$A^*_{ijy} = \beta X_{ijy} + \alpha_{jt} + \epsilon_{ijy}, \quad i = 1, 2, ..., n_{jy} \tag{7}$$

  - i student, j teacher, y year
  - A^*_{ijy} student i's test score in year y
  - X_{ijy} lagged test scores, student demographics, teacher experience, etc.
  - α_{jy} teacher-year fixed effect
  - n_{jy} class size
  - $\epsilon_{ijy} \sim \mathcal{N}(0, \epsilon^2_\epsilon)$ student-specific error term

Value Added Estimation (Cont'd)

- Retrieve estimates for teacher-year fixed effects α_{jt}: $\bar{A}_{jt}$
  - Let $A_{ijy} = A^*_{ijy} - \beta X_{ijy}$; then $\bar{A}_{jy} = \frac{1}{n_{jy}} \sum_{i=1}^{n_{jy}} A_{ijy}$
- Simple fixed effect (MLE) estimator $\bar{A}_j$ has large variance for teachers with few students

$$\bar{A}_j \equiv \frac{\sum_y n_{jy} \bar{A}_{jt}}{\sum_y n_{jy}} \sim \mathcal{N}\left(\alpha_j, \frac{\sigma^2_\epsilon}{\sum_y n_{jy}}\right) \tag{8}$$

  - For teachers observed at treated schools, average value added across pre-entry years

Value Added Estimation (Cont'd)

- Adopt Parametric Empirical Bayes Estimator: $\alpha_j \sim \mathcal{N}(0, \sigma_\alpha^2)$

$$\hat{\alpha}_j = \bar{A}_j \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_\epsilon^2 / \sum_y n_{jy}} \tag{9}$$

  - $\hat{\alpha}_j \to \bar{A}_j$ for large n_{jy}
  - $\hat{\alpha}_j$ shrinks toward zero for small n_{jy}

- Implement via plug-in estimator with MLE

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No Increase In Ability Tracking

VARIABLES	(1) Actual	(2) Simulated
Within 5 miles × Post	-0.011	-0.004
	(0.008)	(0.004)
School size	Y	Y
School white share	Y	Y
School-by-cohort FE	Y	Y
Year-by-cohort FE	Y	Y
Observations	1,548	1,554
R-squared	0.651	0.650
Mean dependent variable pre-entry	0.075	0.054

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No Change In Teacher VA Or Class Size

VARIABLES	(1) Value Added White	(2) Value Added Non-White	(3) Class Size White	(4) Class Size Non-White
Within 5 miles	-0.005	-0.003	0.187	0.208
× Post	(0.006)	(0.006)	(0.253)	(0.241)
Size	Y	Y	Y	Y
% White	Y	Y	Y	Y
School FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	5,724	5,724	4,902	4,902
R-squared	0.733	0.749	0.610	0.624
Mean dep. var.	0.020	0.016	25.361	25.437

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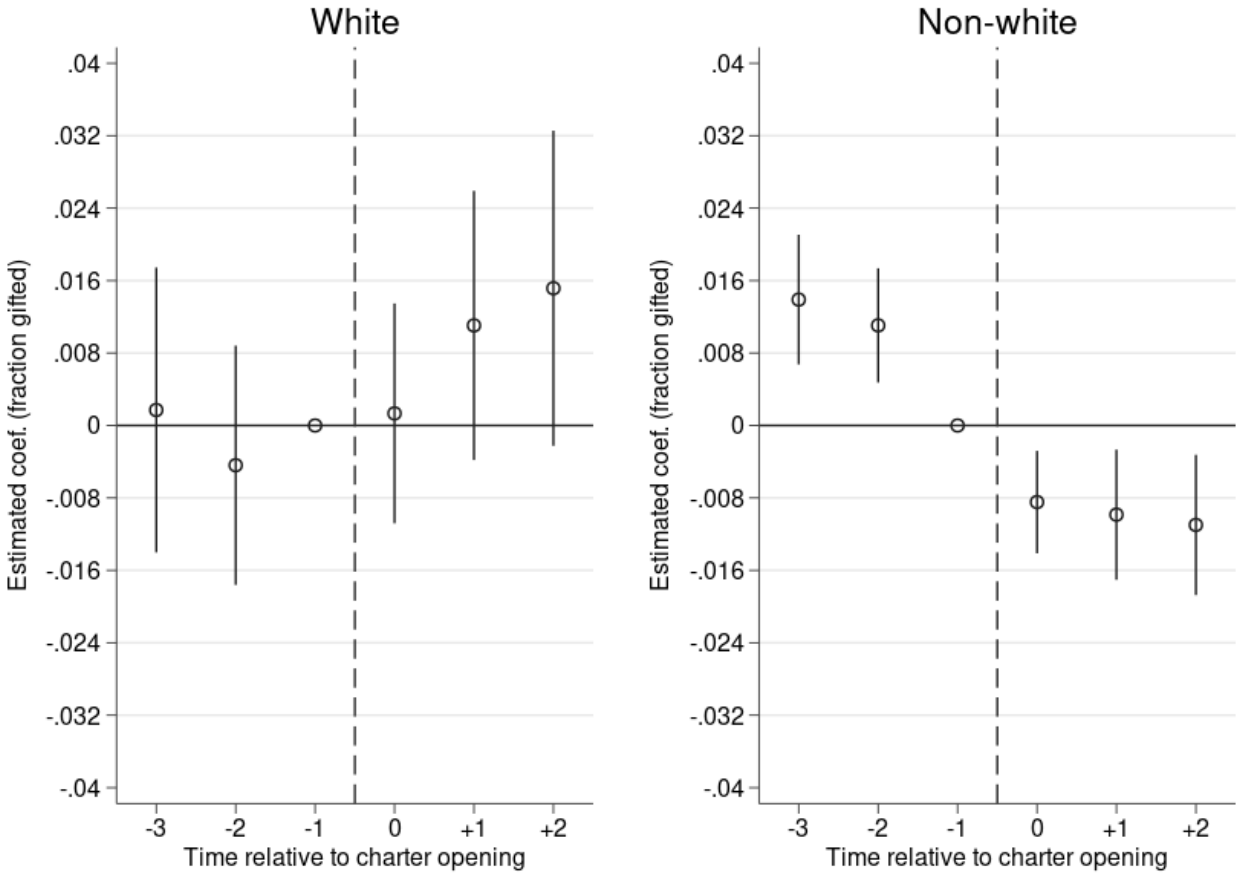
Results For Gifted Education



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Test Score Inequality Widens

VARIABLES	(5) Gifted White	(6) Gifted Non-White	(7) Test Scores P90-P10	(8) Test Scores Racial Gap
Within 5 miles	0.010*	-0.018***	0.057**	0.050***
× Post	(0.006)	(0.003)	(0.026)	(0.018)
Size	Y	Y	Y	Y
% White	Y	Y	Y	Y
School FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	5,892	5,892	3,588	3,588
R-squared	0.804	0.620	0.454	0.678
Mean dep. var.	0.160	0.058	2.328	0.491

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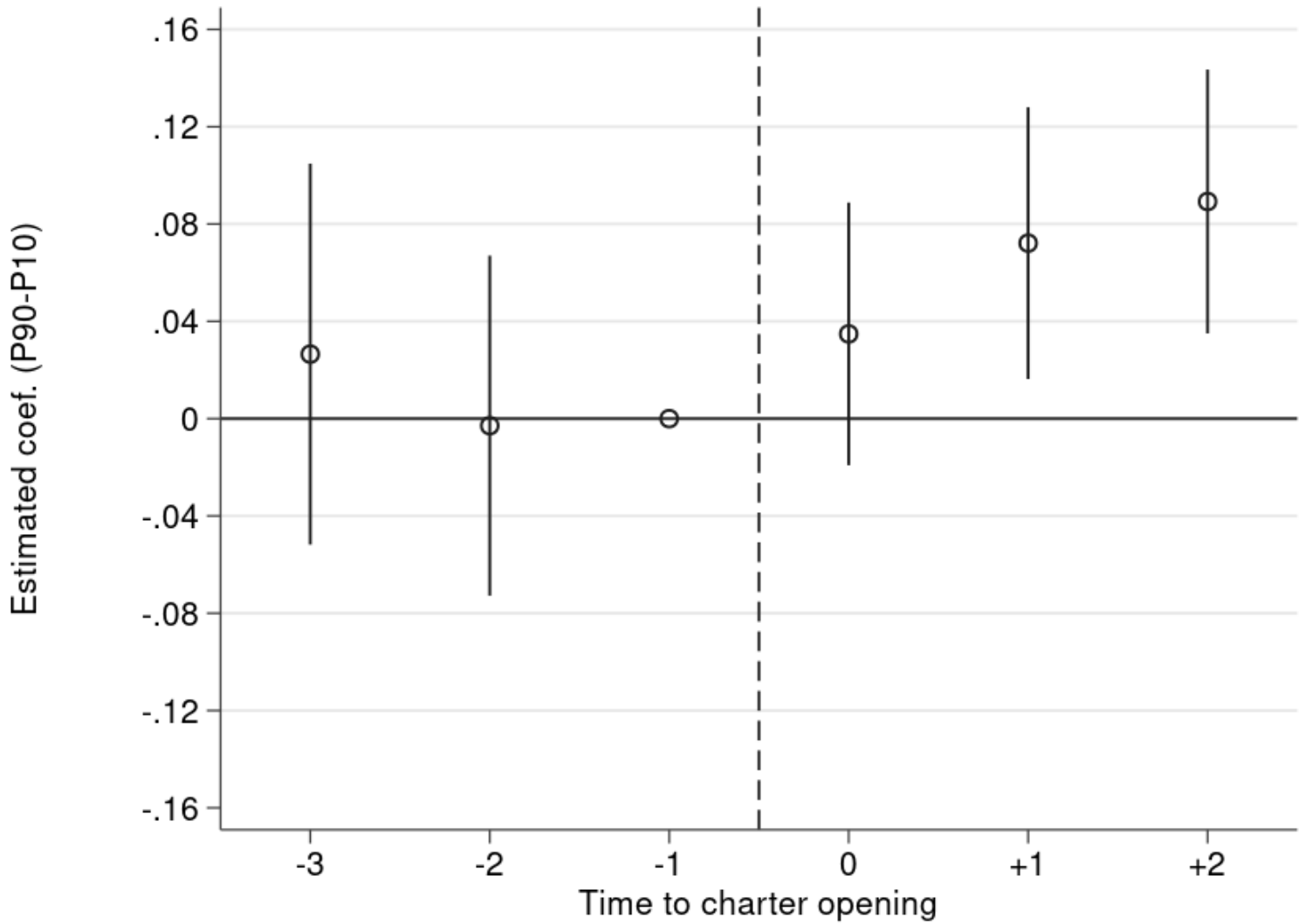
Test Score Inequality Widens



Test Score Inequality Widens