Explaining Charter School Effectiveness

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Key Charter Features

- Each Mass. charter school is a district, answering to the state (public school districts are usually run by cities and towns)
  - ✓ Funded by sending districts and (initially) the state
- State (Commonwealth) charter schools are outside local collective bargaining agreements
  - ✓ State charters hire, fire, and have loose work rules much like private schools
  - ✓ Charter teachers need not be certified, but must pass the state ed test in first year of work
- Charter schools are meant to be accountable
  - ✓ A charter is subject to periodic review; may be suspended, revoked, or non-renewed
  - ✓ Accountability criteria: success of academic program; organizational viability; faithfulness to a charter
  - ✓ Of 75 Mass. charters granted thru 2009, 9 have been lost
- The charter universe is highly heterogeneous
- The agenda today: explore and explain what this means for causal effects

The Massachusetts Charter Landscape

- Charter school admissions
  - ✓ No tests, must admit special ed and LEP students
  - ✓ Use lotteries when oversubscribed
- Mass. charters account for less than %5 of middle and less than %2 percent of high school enrollment, but growing rapidly
  - ✓ Today: 16 charter schools in Boston and 47 elsewhere; up from 39 statewide in 1999
  - ✓ Charters account for almost %10 of urban middle school and almost %5 of urban high school enrollment
- Key policy developments
  - ✓ Mass. charter enrollment is capped; A 2010 law lifts the cap for "proven providers" in low-MCAS districts
  - ✓ 14 new Commonwealth charters under this provision in February of this year
  - ✓ All are urban schools in high-poverty districts (in Boston, New Bedford, Lawrence, Chelsea, and Springfield)

Charter Campus Heterogeneity

- A key distinction in our work is between urban and non-urban schools, the former characterized by high minority and high-poverty student populations
- Urban districts are defined as those that participate in the Mass. Urban Superintendent's Network
- These districts include
  - ◇ Boston and poorer suburbs (e.g., Cambridge, Brockton, Lynn, Quincy, Revere)
  - ◇ Low-income, densely populated areas (e.g., Fall River, New Bedford, Springfield, Worcester)
- Other possible classification schemes
  - ✓ Title I status
  - ✓ Gleason et. al. (2010): majority non-white student population, majority free lunch
- Virtually identical to our urban/non breakdown
- Urban/non is also associate with important differences in school practice and characteristics, as shown below

School Characteristics Differ Across Settings [fwd]

	Statewide	Urban	Non-urban
Time in School			
Days per School Year	186.18	188.53	182.55
Average Minutes per Day	447.86	464.35	422.36
Have Saturday School	32.1%	47.1%	9.1%
Avg. Math Instruction (min)	80.93	94.56	59.86
Avg. Reading Instruction (min)	84.00	99.62	59.86
Affiliation and Philosophy			
CMO or Network Affiliation	35.7%	29.4%	45.5%
Fully or somewhat "No excuses"	42.9%	70.6%	0.0%
Parent contract	67.9%	82.4%	45.5%
Student contract	64.3%	70.6%	54.5%
Uniforms	82.1%	88.2%	72.7%
Reward and Punishment System	46.4%	64.7%	18.2%
Funding			
Avg. Per-pupil	$12,824	$14,095	$11,090
Title I eligible	85.7%	100.0%	63.6%
Schools participating in survey	28	17	11

Charter Effect Heterogeneity

- We looked previously at schools in two urban settings
  - ✓ Large gains for Boston-area charter students: 0.43σ per year in MS Math, 0.19σ for MS ELA; similar HS results
  - ✓ And at a KIPP school in Lynn: 0.35σ per year in Math, 0.12σ in English
- Dobbie and Fryer (2011) report similarly large results at charters in the Harlem Children's Zone
- 2010 Gleason et. al. MPR lottery study (29 middle school sites; 15 states; 2330 applicants) is more mixed
  - ✓ "Charter middle schools that hold lotteries are neither more nor less successful on average than traditional public schools"
  - ✓ But charter schools are effective for low income students and those in large urban areas
- Our 2011 statewide lottery sample (21 middle and high schools; 8000 applicants) also generates mixed results (the starting point for this talk)

Data Details

1. Quasi-experimental sample:
   - ✓ Charter applicants to over-subscribed statewide charters with usable lottery records
     - ◇ excluding guaranteed and sibling priority
     - ◇ including only those applying for typical entry grades and on-time applicants
   - ✓ With baseline data from 2002-2009, MCAS outcomes for 2004-2010
2. Observational sample:
   - ✓ Students in state (SIMS) data files; with baseline demographics
   - ✓ With baseline data from 2002-2008, including lagged scores
   - ✓ With MCAS outcomes for 2004-2010
   - ✓ Students in charters *eligible* for our lottery study were matched to a sample of traditional students as controls

- School participation is detailed below

School Participation

	All Charters with Mid/High Grades	Obs/Eligible for Lottery	Included in Lottery
MS and HS		35	21
		I. Middle Schools	
Total	54	27	16
Urban	35	16	9
Boston	13	8	7
Non-Boston	22	8	2
Non-Urban	19	11	7
		II. High Schools	
Total	37	8	6
Urban	25	6	4
Boston	10	5	4
Non-Boston	15	1	0
Non-Urban	12	2	2

Coverage Notes

- We start with all charter schools admitting in middle and high school grades
- Eligible schools drawn from this list include those that:
  - ✓ Opened no later than 2009
  - ✓ Are currently open
  - ✓ Serve traditional students
- The *observational/eligible sample*: students at these schools and a matched comparison group
- The *charter lottery sample* includes applicants to eligible over-subscribed charters with usable lottery records
  - ✓ 16/27 middle schools (9/16 urban, 7/11 nonurban)
  - ✓ 6/8 high schools (4/6 urban, 2/2 nonurban)
- **Table 3** shows demographics and baseline scores by school type for students in obs/eligible and lottery samples

Descriptive Statistics

- Important urban/non-urban differences
  - ✓ Traditional urban students much more likely to be minority, to be LEP, special ed, and to receive a subsidized lunch than traditional students elsewhere
  - ✓ Urban students also have much lower baseline test scores than other public school students (baseline scores are from 4th grade for middle schoolers and 8th grade for high schoolers)
  - ✓ Charter students in urban and non-urban areas are more similar to their peers in regular public schools than to one another
- Important differences by charter status
  - ✓ In urban middle school charters, more Black and fewer Hispanic or LEP, less likely to participate in special ed, similar poverty [FRPL] rates
  - ✓ Applicants to urban middle school charters have moderately higher baseline scores than their traditional school counterparts, as do non-urban charter applicants
  - ✓ Broadly similar patterns in the high school sample (FRPL rates somewhat higher for HS charter students)

Lottery Estimates

Quasi-experimental Design

- We studied applicants for charter seats in 4-7th (middle school) and 9th grade (high school)
  - ✓ Charters run and document their own lotteries
  - ✓ Our charter applicant file includes non-sibling first-round applicants who apply to schools in our sample
  - ✓ Charters are city-wide with no walk zones

- The **charter lottery instrument** indicates students offered a seat at any charter to which they applied

- **Charter risk sets** are defined by the set of schools to which an applicant applied (e.g., 3 schools generate 7 risk sets)

Threats to Validity

- Are lottery offers independent of student characteristics?
- **Table A2** reports on covariate balance in the lottery sample
  - ✓ A couple marginally significant differences, but there are many contrasts to look at!
  - ✓ Most differences are small
  - ✓ Joint tests are encouraging
- Attrition: **Table A3**
  - ✓ Over 90% followup in MS, almost 80% followup in HS
  - ✓ Win/loss differentials significant for MS, but small and unlikely to impart substantial selection bias
  - ✓ High follow-up rates due to statewide data and public school baseline restrictions

2SLS Strategy

- The second stage controls for lottery risk sets:

$$y_{igt} = \alpha_{2t} + \beta_{2g} + \sum_j \delta_j d_{ij} + \tau s_{igt} + \epsilon_{igt}, \quad (1)$$

  where d_{ij} indicates i in risk set j, with effect δ_j; α_{2t} and β_{2g} are year-of-test and grade-of-test effects; s_{igt} is years in charter

- The corresponding first stage is:

$$s_{igt} = \alpha_{1t} + \beta_{1g} + \sum_j \kappa_j d_{ij} + \pi Z_i + \eta_{igt} \quad (2)$$

- The instrument, Z_i, indicates lottery offers from schools in student i's risk set
- Over-identified models introduce a risk-set-specific first stage $(\pi_j * d_{ij} Z_i)$
- We start by estimating equations 1-2 statewide
- Results in **Table 4**

Statewide Lottery Results: Urban vs Non

- Urban and non-urban risk sets are disjoint; it's therefore straightforward to estimate (1-2) separately by location
- Urban vs nonurban results: **Table 5** documents a marked difference in impact
- Subgroup estimates
  - ✓ Show larger gains for nonwhite, poor (FRPL), and low baseline middle school students: **Table 6**
  - ✓ Within subgroups, however, there is still a consistent urban advantage
- What are the sources of the urban charter advantage? What explains it?
- Candidates:
  - ✓ Differences in non-charter fallback or baseline achievement
  - ✓ Student demographics
  - ✓ School inputs or philosophy
- We'll explore these next . . .

Interpreting and Explaining Charter Effect Heterogeneity

Agenda

A. Interpreting urban charter effects
   - We ask: *Are urban gains driven by differences in non-charter fallback?*
   - Our answer decomposes effects into components attributable to treated and non-treated counterfactuals

B. Explaining the urban charter advantage
   - We ask: *Are urban gains attributable to differences in student demographics or differing school characteristics?*
   - Answer using a Blinder-Oaxaca decomposition for student demographics and a school-level regression analysis of observational estimates

- Notation
  - We simplify by focusing on a dummy for charter enrollment, D, and focus on effects one year out for math and two years out for ELA
  - School location indicated by subscript $l = \{u, n\}$, or dummy, U

Urban Charter Students Face a Worse Fallback

- Decompose difference in urban/non-urban effects:

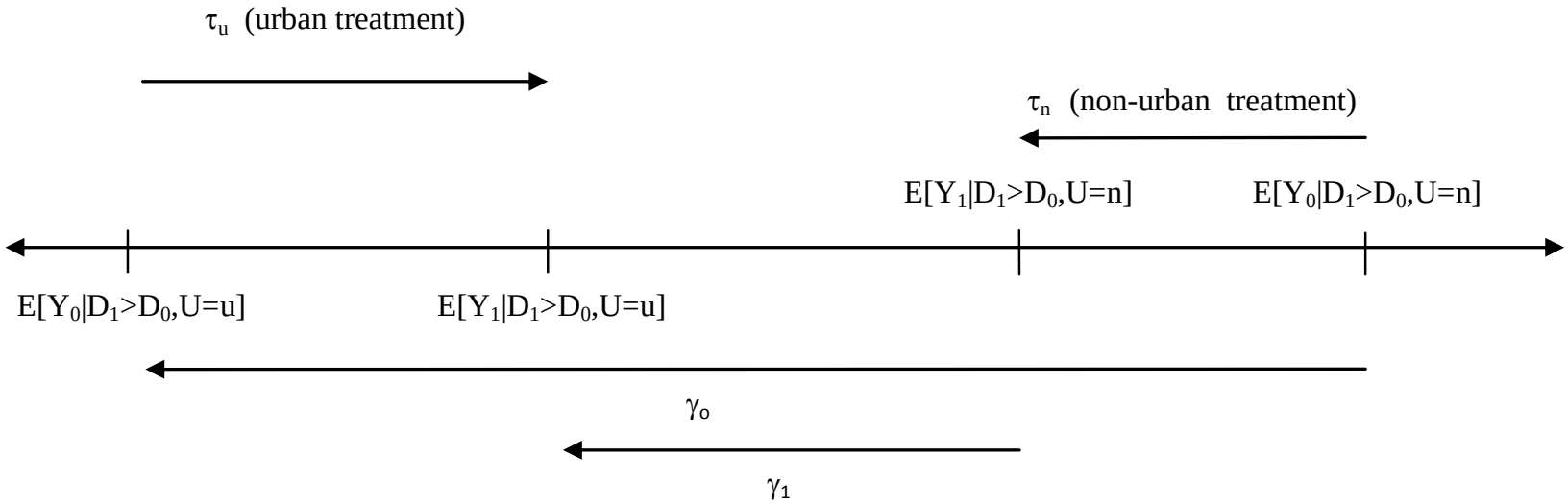
$$\begin{aligned} E_u[Y_1 - Y_0|\text{complier}] - E_n[Y_1 - Y_0|\text{complier}] \\ &\equiv \tau_u^c - \tau_n^c \\ &= \underbrace{(E_u[Y_1|\text{c}] - E_n[Y_1|\text{c}])}_{\gamma_1} + \underbrace{(E_n[Y_0|\text{c}] - E_u[Y_0|\text{c}])}_{\gamma_0} \end{aligned}$$

- Empirical equations for γ_0 and γ_1 (estimated using a bernoulli instrument; based on Abadie 2003):

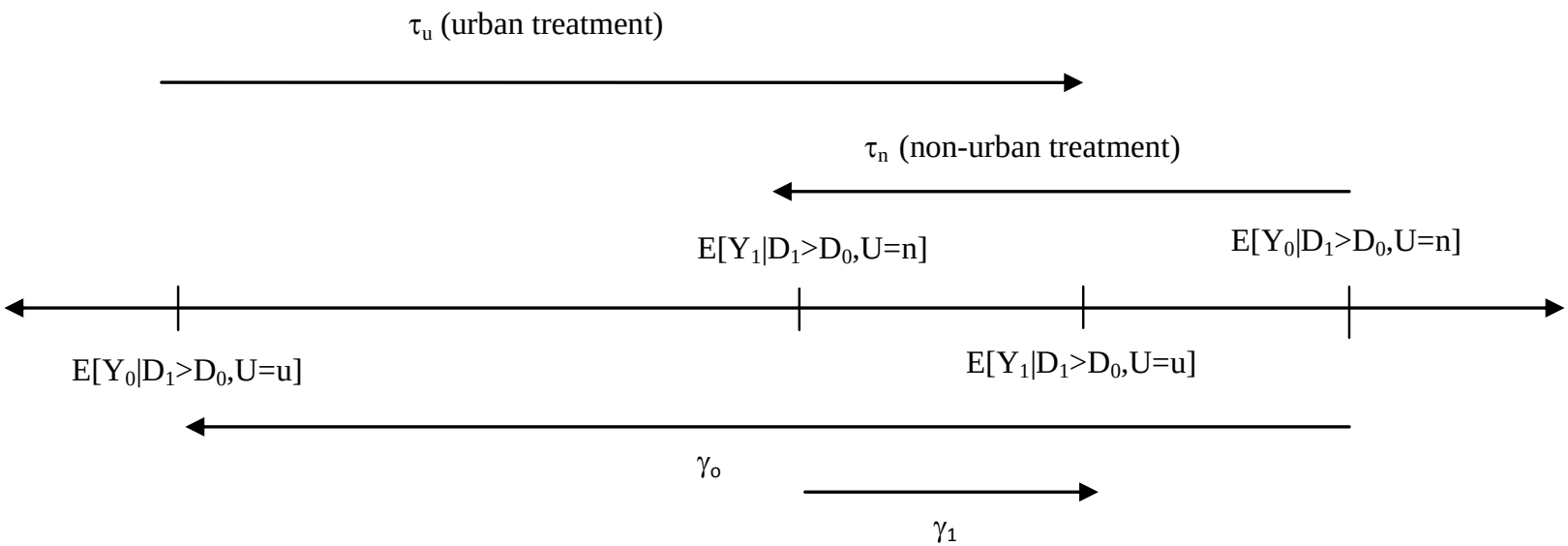
$$Y(1-D) = \mu_{00} + \mu_{01}U + E_n[Y_0|\text{c}](1-D) - \gamma_0(1-D)U + \eta_0$$
$$YD = \mu_{10} + \mu_{11}U + E_n[Y_1|\text{c}]D + \gamma_1 DU + \eta_1$$

- In these equations, DU and $(1-D)U$ interactions are treated as endogenous, along with the D and $(1-D)$ main effects
- 2SLS estimates use lottery win/loss interacted with risk set dummies as instruments (risk sets absorb urban)
- **Results** show urban/non Y_1 to be similar; but urban charter students get there from a much lower Y_0

ELA:


τ_u (urban treatment)
τ_n (non-urban treatment)
$E[Y_1|D_1>D_0,U=n]$
$E[Y_0|D_1>D_0,U=n]$
$E[Y_0|D_1>D_0,U=u]$
$E[Y_1|D_1>D_0,U=u]$
γ_o
γ_1

Math:


τ_u (urban treatment)
τ_n (non-urban treatment)
$E[Y_1|D_1>D_0,U=n]$
$E[Y_0|D_1>D_0,U=n]$
$E[Y_0|D_1>D_0,U=u]$
$E[Y_1|D_1>D_0,U=u]$
γ_o
γ_1

Locally High Urban Y_1 . . . not Low Y_0

Decompose Urban LATE into treated and non-treated gap:

$$E_u[Y_1|\text{complier}] - E_u[Y_0|\text{complier}]$$
$$= \underbrace{(E_u[Y_1|c] - E_u[Y_0|D=0])}_{\lambda_1 \text{ (treated gap)}} + \underbrace{(E_u[Y_0|D=0] - E_u[Y_0|c])}_{\lambda_0 \text{ (untreated gap)}}$$

- We can show that urban compliers have Y_0 *typical of where they come from*
- Urban charter gains can therefore be understood as being generated by gains in Y_1
- Specifically, under

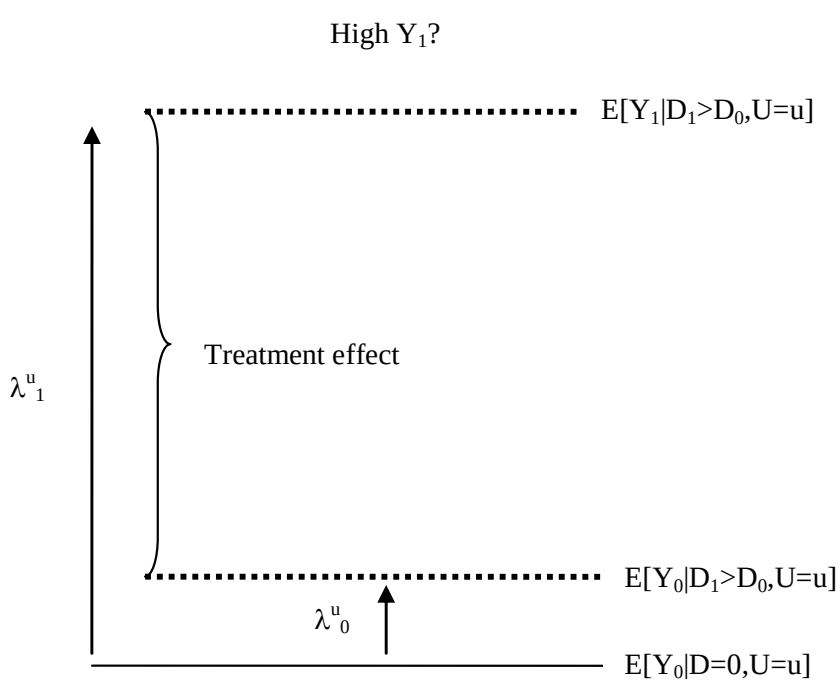
$$H_0 : E_u[Y_0|c] = E_u[Y_0|D=0],$$

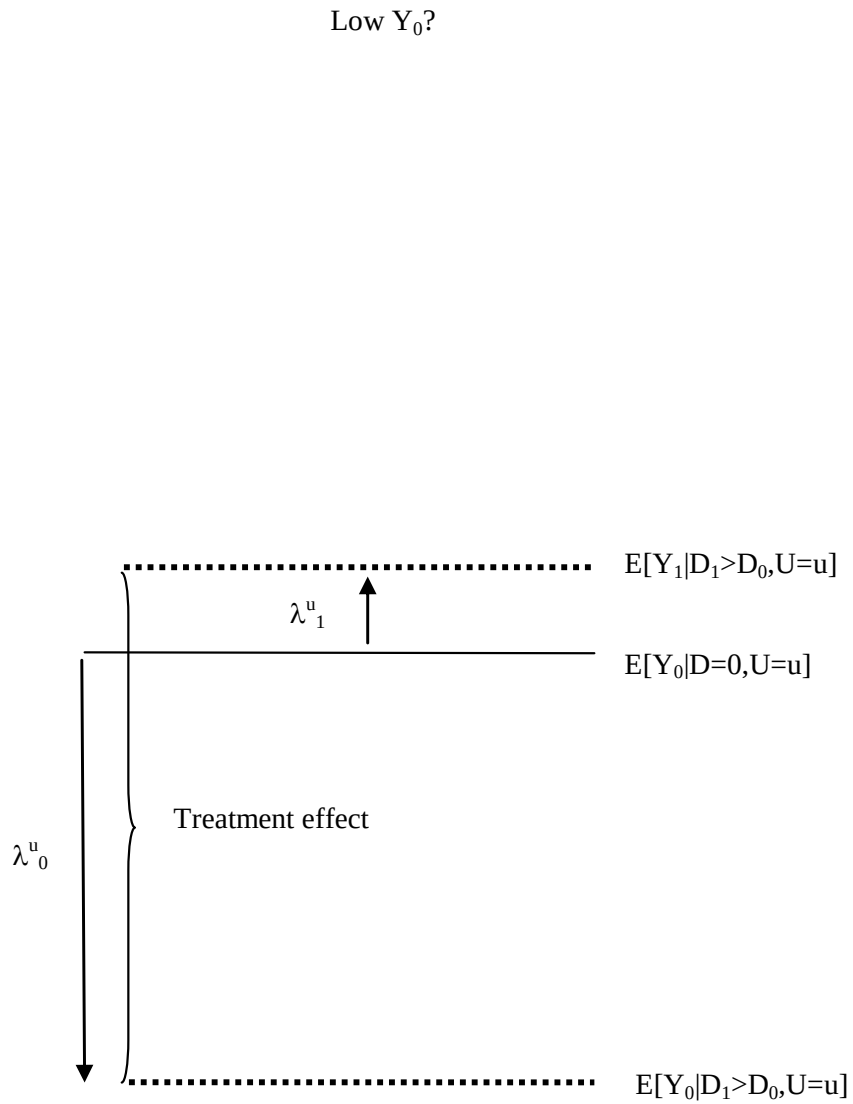
we have

$$\lambda_0 = 0,$$

in which case, the urban charter advantage comes entirely from Y_1 rising beyond local non-charter achievement

High Y_1 or low Y_0?





High Y_1 or low Y_0: Estimation

- $E_u[Y_0|D=0]$ is population OLS α_0 in:

$$Y(1-D) = \mu_0 + \alpha_0(1-D) + \epsilon \tag{3}$$

  where μ_0=0

- $E_u[Y_0|c]$ is the population IV estimate this equation generates; call this α_1 (Abadie 2003)

- Following Hausman (1978), the non-treated gap (the difference between OLS and IV) is [proportional to] the coefficient θ on $\hat{u}$ in

$$Y(1-D) = \mu_1 + \alpha_1(1-D) + \theta\hat{u} + \nu$$

  where $\hat{u}$ is the first-stage residual for IV estimates of (3)

- We explore **two versions** of this analysis, with and without non-applicants contributing to Y_0

Different students?

- We start with models allowing for covariate (demos, baseline score) interactions by campus location l:

$$y_{il} = \sum_j \delta_{jl} d_{ij} + (\tau_l + \rho_l' X) s_i + \epsilon_{il}; l = u, n \tag{4}$$

- Iterating expectations gives overall effect for location l:

$$E_l[Y_1 - Y_0|\mathrm{c}] = E_l[E_l[Y_1 - Y_0|\mathrm{c}, X]] = \tau_l^c = \tau_l + E_l[X]'\rho_l$$

- BO Decomposition (two ways):

$$\begin{aligned}
\tau_u^c - \tau_n^c &= (\tau_u - \tau_n) + (E_u[X]'\rho_u - E_n[X]'\rho_n) \\
&= (\tau_u - \tau_n) + E_n[X]'(\rho_u - \rho_n) + (E_u[X] - E_n[X])'\rho_u \\
&= \underbrace{(\tau_u - \tau_n) + E_u[X]'(\rho_u - \rho_n)}_{\text{cov-specific TEs}} + \underbrace{(E_u[X] - E_n[X])'\rho_n}_{\text{cov levels}}
\end{aligned}$$

- Demo diffs can be weighted by either urban or nonurban ρ
- The **first scheme** asks: what if urban schools had non-urban demos; the second flips this

The Story So Far

A. Interpreting urban charter effects
   - The noncharter fallback for urban students is indeed below the fallback for nonurban
   - But urban charter schools push their students well beyond the local counterfactual, while nonurban charters leave their students static at the higher nonurban baseline

B. Explaining the urban charter advantage
   - Urban schools are more effective for minorities, low income; the population these schools serve explains some (though not all) of the large urban charter gains
   - Nonurban charters are uniformly ineffective: were nonurban charter students to have urban demographics, these schools would still accomplish little

- We turn next to a school-level analysis, focusing on the distinction between *No Excuses* and other charters
  - KIPP is emblematic of the *No Excuses* paradigm; these schools are characterized by . . .

Observational Estimates for School-Level Analysis

- We begin with a pooled OLS analysis that mirrors our 2SLS setup, using the full sample of eligible charter students with matched district controls
- Observational estimates are from:

$$y_{igtc} = \alpha_t + \beta_g + \iota_c + \theta' b_i + \tau_o' S_{igt} + \epsilon_{igt} \quad (5)$$

  - ✓ Includes year effects, grade effects, and matching cell effects
  - ✓ b_i includes baseline scores in each subject
  - ✓ S_{igt} is a *vector* of years in eligible charters, ineligible charters, alternative schools, and exam/magnet schools from baseline to year t
  - ✓ s.e.s clustered on student when grades are stacked, and always on school-by-year (2-way)
- This is estimated in the matched obs/eligible sample
- Observational and lottery estimates **compared**

School-Specific Impact Analysis

- Our school survey covers inputs and approach for most of our eligible charters (described in **school characteristics table**)
- We're continuing to collect this data (currently have info for 30/35 schools)
- We regress school-level estimates on campus location, with controls for inputs and approach (a *No Excuses* indicator)
- Results **here**
  - ✓ School covs as a group seem to explain something, but a single *No Excuses dummy* is sufficient to kill both the Urban and Lottery-sample effects
  - ✓ This works with or without school covs
- Other evidence for the role of *No Excuses* in urban charter schools (not reported here): big increase in suspensions; decline in HS truancy
- Work in progress: post-secondary outcomes

Summary

- The role of no-treatment counterfactuals
  - ✓ Urban charter students make important gains relative to *their* low noncharter starting point: charter attendence pushes them to suburban achievement levels
  - ✓ Nonurban charter students have better non-charter outcomes, but charter attendance adds nothing to these
- Demographics
  - ✓ Demographics explain part of the urban charter advantage: urban charter middle schools are especially effective with minority/poor applicants
  - ✓ Little evidence that non-urban charters are effective: changing the demographic mix to be more urban would not produce significant gains at non-urban middle schools
- A school-level analysis points to *No Excuses* as the key to urban charter success
- Urban charters are showing encouraging results, but charter autonomy alone is not guaranteed to produce good outcomes

Additional Material

Table 3: Descriptive Statistics

	Regular Public Schools		Charter schools (eligible)		Charter applicants (lottery)	
	Urban	Non-urban	Urban	Non-urban	Urban	Non-urban
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Middle Schools (5th-8th grade)					
Female	0.486	0.488	0.498	0.476	0.496	0.510
Black	0.185	0.027	0.407	0.036	0.479	0.022
Hispanic	0.314	0.036	0.237	0.048	0.234	0.025
Special education	0.190	0.163	0.166	0.160	0.176	0.184
Subsidized lunch	0.681	0.141	0.650	0.216	0.686	0.102
Limited English proficiency	0.150	0.016	0.077	0.025	0.086	0.008
Baseline Math score	-0.430	0.213	-0.339	0.239	-0.352	0.306
Baseline ELA score	-0.464	0.234	-0.330	0.261	-0.373	0.392
Years in charter	0.000	0.000	2.027	1.960	1.341	1.002
N (students)	153374	369866	6625	8316	4126	1693
N (schools)	262	390	16	11	9	7

Table 3: Descriptive Statistics

	Regular Public Schools		Charter schools (eligible)		Charter applicants (lottery)	
	Urban	Non-urban	Urban	Non-urban	Urban	Non-urban
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel B. High Schools (10th grade)			
Female	0.500	0.494	0.555	0.549	0.549	0.539
Black	0.190	0.028	0.535	0.020	0.615	0.029
Hispanic	0.272	0.032	0.176	0.010	0.256	0.017
Special education	0.169	0.155	0.160	0.105	0.174	0.115
Subsidized lunch	0.606	0.122	0.600	0.146	0.716	0.120
Limited English proficiency	0.093	0.009	0.022	0.005	0.035	0.003
Baseline Math score	-0.420	0.271	-0.413	0.322	-0.315	0.445
Baseline ELA score	-0.387	0.282	-0.325	0.413	-0.306	0.562
Years in charter	0.000	0.000	1.765	1.797	0.627	1.292
N (students)	116593	313366	2198	783	2973	349
N (schools)	101	304	8	2	4	2

Table A2: Covariate Balance

	Middle school		High school	
	All lotteries	Lotteries with baseline scores	All lotteries	Lotteries with baseline scores
	(1)	(2)	(3)	(4)
Hispanic	0.007	0.010	0.014	0.000
	(0.011)	(0.011)	(0.018)	(0.019)
Black	0.012	0.006	-0.002	0.011
	(0.012)	(0.013)	(0.020)	(0.022)
White	-0.010	-0.009	-0.008	-0.011
	(0.010)	(0.011)	(0.011)	(0.012)
Asian	0.002	0.003	0.001	-0.001
	(0.004)	(0.005)	(0.007)	(0.008)
Female	0.016	0.018	0.008	0.014
	(0.015)	(0.016)	(0.021)	(0.022)
Subsidized Lunch	0.007	0.008	0.020	0.001
	(0.013)	(0.013)	(0.018)	(0.020)
Special Education	-0.010	-0.011	-0.002	-0.003
	(0.012)	(0.012)	(0.016)	(0.017)
Limited English Proficiency	-0.008	-0.006	0.014*	0.011
	(0.008)	(0.008)	(0.007)	(0.007)
Baseline ELA Score	-	0.017	-	-0.072*
		(0.030)		(0.037)
Baseline Math Score	-	0.008	-	-0.057
		(0.030)		(0.040)
Baseline Writing Composition Score	-	-	-	0.023
				(0.039)
Baseline Writing Topic Score	-	-	-	-0.063
				(0.039)
p-value, from F-test	0.423	0.753	0.695	0.141
N	6214	5784	4207	3549

Table A3: Attrition

School level	Subject		Proportion of non-offered with MCAS	Differential	
				Demographic controls	Demographics and baseline scores
			(1)	(2)	(3)
Middle	ELA		0.911	0.016**	0.010
				(0.008)	(0.008)
		N	2348	6214	5873
	Math		0.916	0.011	0.007
				(0.008)	(0.008)
		N	2348	6214	5805
High	ELA		0.787	0.008	0.007
				(0.017)	(0.018)
		N	1332	4207	3687
	Math		0.773	0.010	0.004
				(0.018)	(0.018)
		N	1332	4207	4060
	Writing Topic and Writing Composition		0.773	0.010	0.003
				(0.018)	(0.019)
		N	1332	4207	3620

Table 4: Lottery Results for Massachusetts Charter Schools

					2SLS	
			First Stage	Reduced Form	Just identified	Overidentified
School level	Subject		(1)	(2)	(3)	(4)
Middle	ELA		0.987***	0.065**	0.066**	0.062**
			(0.043)	(0.029)	(0.029)	(0.028)
		N			12126	
	Math		0.984***	0.211***	0.214***	0.175***
			(0.043)	(0.034)	(0.033)	(0.031)
		N			12346	
High	ELA		0.509***	0.113**	0.221***	0.190**
			(0.101)	(0.050)	(0.076)	(0.074)
		N			3303	
	Math		0.510***	0.164**	0.322***	0.269***
			(0.101)	(0.064)	(0.090)	(0.093)
		N			3255	
	Writing Topic		0.514***	0.156***	0.303***	0.290***
			(0.101)	(0.057)	(0.087)	(0.080)
		N			3268	
	Writing Composition		0.514***	0.140**	0.271***	0.227***
			(0.101)	(0.058)	(0.092)	(0.085)
		N			3268	

Table 5: Lottery Results for Urban and Non-urban Charter Schools

			Urban			Non-urban		
			First Stage	Reduced Form	2SLS	First Stage	Reduced Form	2SLS
School level	Subject		(1)	(2)	(3)	(4)	(5)	(6)
Middle	ELA		1.001***	0.141***	0.140***	0.978***	-0.155***	-0.156***
			(0.055)	(0.035)	(0.033)	(0.081)	(0.045)	(0.045)
		N		8762			3364	
	Math		0.990***	0.333***	0.336***	0.996***	-0.159***	-0.155***
			(0.054)	(0.038)	(0.036)	(0.081)	(0.050)	(0.051)
		N		9015			3331	
High	ELA		0.494***	0.117**	0.236***	1.082***	-0.014	-0.009
			(0.105)	(0.051)	(0.079)	(0.153)	(0.116)	(0.105)
		N		2954			349	
	Math		0.495***	0.178***	0.359***	1.088***	-0.274*	-0.246*
			(0.105)	(0.066)	(0.092)	(0.158)	(0.162)	(0.148)
		N		2910			345	
	Writing Topic		0.500***	0.166***	0.332***	1.082***	-0.157	-0.139
			(0.105)	(0.058)	(0.090)	(0.153)	(0.222)	(0.204)
		N		2920			348	
	Writing Composition		0.500***	0.149**	0.298***	1.082***	-0.155	-0.137
			(0.105)	(0.060)	(0.096)	(0.153)	(0.213)	(0.196)
		N		2920			348	

Table 6: 2SLS Estimates for Subgroups at Urban Charter Schools

			Sex		Race			Subsidized	Lowest baseline
			Female	Male	Black	Hispanic	White	lunch	quartile
School level	Subject		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Middle	ELA		0.110**	0.171***	0.222***	0.218***	0.023	0.189***	0.307***
			(0.044)	(0.047)	(0.056)	(0.058)	(0.057)	(0.039)	(0.074)
		N	4405	4357	4152	1960	1982	5945	2082
	Math		0.394***	0.287***	0.502***	0.378***	0.109*	0.365***	0.420***
			(0.050)	(0.048)	(0.059)	(0.060)	(0.064)	(0.041)	(0.064)
		N	4535	4480	4312	2015	2014	6112	2148
High	ELA		0.172*	0.272**	0.222**	0.302*	0.047	0.191**	0.251
			(0.101)	(0.115)	(0.087)	(0.174)	(0.629)	(0.088)	(0.165)
		N	1625	1329	1817	756	227	2118	621
	Math		0.400***	0.306**	0.384***	0.189	0.641	0.298***	0.450***
			(0.122)	(0.132)	(0.101)	(0.210)	(0.495)	(0.104)	(0.132)
		N	1600	1310	1791	743	226	2086	679
	Writing Topic		0.320***	0.317***	0.452***	-0.188	0.116	0.271**	0.358**
			(0.119)	(0.110)	(0.097)	(0.239)	(0.665)	(0.106)	(0.150)
		N	1611	1309	1794	747	225	2093	679
	Writing Composition		0.231*	0.348***	0.369***	0.128	0.460	0.227**	0.347*
			(0.124)	(0.131)	(0.106)	(0.249)	(0.582)	(0.114)	(0.181)
		N	1611	1309	1794	747	225	2093	679

Table 7: 2SLS Estimates for Subgroups at Non-urban Charter Schools

			Sex		Race			Subsidized	Lowest baseline
			Female	Male	Black	Hispanic	White	lunch	quartile
School level	Subject		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Middle	ELA		-0.202***	-0.117*	0.148	-0.151	-0.156***	-0.196*	-0.215***
			(0.058)	(0.068)	(0.587)	(0.273)	(0.046)	(0.118)	(0.077)
		N	1702	1662	67	94	3043	308	795
	Math		-0.220***	-0.105	0.153	-0.577	-0.138***	-0.168	-0.251***
			(0.067)	(0.073)	(0.626)	(0.381)	(0.049)	(0.157)	(0.075)
		N	1687	1644	65	96	3009	298	716
High	ELA		0.166	-0.267	-	-	-0.022	-0.579***	-0.031
			(0.122)	(0.183)			(0.109)	(0.208)	(0.135)
		N	188	161			325	42	76
	Math		-0.193	-0.347	-	-	-0.247	-0.052	-0.081
			(0.165)	(0.239)			(0.166)	(0.049)	(0.059)
		N	187	158			322	40	74
	Writing Topic		0.073	-0.480	-	-	-0.180	-2.713***	-0.396**
			(0.178)	(0.392)			(0.200)	(0.102)	(0.167)
		N	187	161			325	41	74
	Writing Composition		0.022	-0.379	-	-	-0.161	-1.320***	-0.293
			(0.262)	(0.312)			(0.194)	(0.191)	(0.386)
		N	187	161			325	41	74

Table 8: Urban Gaps in Treatment and No-treatment Counterfactuals

					Differences in potential outcomes	
		Urban effect	Non-urban effect	Effect difference	Υ_0	Υ_1
School level	Subject	(1)	(2)	(3)	(4)	(5)
Middle	ELA	0.154**	-0.218***	0.371***	-0.705***	-0.333***
		(0.074)	(0.054)	(0.092)	(0.081)	(0.065)
	N	3817	1851	5668	5668	5668
	Math	0.468***	-0.252***	0.720***	-0.628***	0.092
		(0.084)	(0.072)	(0.111)	(0.085)	(0.071)
	N	4127	1768	5895	5895	5895

Table 9: Non-treated Gaps in Urban Areas

			Treatment Effect	Non-applicants included			Non-applicants excluded		
				$E[Y_0\|D=0,U=u]$	λ_0^u	λ_1^u	$E[Y_0\|D=0,U=u]$	λ_0^u	λ_1^u
School level	Subject		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Middle	ELA		0.152**	-0.417***	0.116*	0.268***	-0.273***	-0.028	0.124**
			(0.074)	(0.013)	(0.062)	(0.058)	(0.037)	(0.047)	(0.061)
		N			102238			3752	
	Math		0.470***	-0.402***	0.071	0.540***	-0.318***	-0.014	0.456***
			(0.085)	(0.012)	(0.054)	(0.062)	(0.034)	(0.041)	(0.071)
		N			145925			4062	
High	ELA		0.346**	-0.368***	0.026	0.372***	-0.300***	-0.073	0.285**
			(0.166)	(0.020)	(0.104)	(0.139)	(0.034)	(0.100)	(0.142)
		N			129062			3256	
	Math		0.647***	-0.373***	0.002	0.639***	-0.277***	-0.117	0.533***
			(0.175)	(0.023)	(0.116)	(0.175)	(0.046)	(0.115)	(0.174)
		N			127196			3210	

Table 10: Non-treated Gaps in Non-urban Areas

			Treatment Effect	Non-applicants included			Non-applicants excluded		
				$E[Y_0 \mid D=0, U=n]$	λ_0^n	λ_1^n	$E[Y_0 \mid D=0, U=n]$	λ_0^n	λ_1^n
School level	Subject		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Middle	ELA		-0.198***	0.265***	0.124**	-0.078**	0.392***	0.010	-0.207***
			(0.050)	(0.007)	(0.050)	(0.033)	(0.032)	(0.036)	(0.043)
		N			273443			1851	
	Math		-0.234***	0.238***	0.060	-0.192***	0.304***	-0.006	-0.258***
			(0.073)	(0.007)	(0.063)	(0.039)	(0.041)	(0.047)	(0.055)
		N			326982			1768	

Table 11: Decomposition of Urban Differences in Impact

				Decomposition 1 (urban loading)		Decomposition 2 (non-urban loading)	
School level	Subject		Urban vs. non-urban difference in TE (1)	Due to diffs in cov. levels (2)	Due to diffs in cov-specific TE (3)	Due to diffs in cov. levels (4)	Due to diffs in cov-specific TE (5)
Middle	ELA		0.403***	0.252***	0.151	0.057	0.345
			(0.079)	(0.086)	(0.104)	(0.399)	(0.436)
		N	4523				
	Math		0.675***	0.329***	0.346***	0.248	0.428
			(0.074)	(0.081)	(0.093)	(0.333)	(0.353)
		N	4521				

Table 12: Comparison of Lottery and Observational Estimates for Eligible Charters

			Urban			Non-urban		
				Observational estimates			Observational estimates	
School level	Subject		Lottery estimate (1)	Lottery sample (2)	Non-lottery sample (3)	Lottery estimate (4)	Lottery sample (5)	Non-lottery sample (6)
Middle	ELA		0.140***	0.174***	-0.035***	-0.156***	-0.015**	-0.019
			(0.033)	(0.011)	(0.012)	(0.045)	(0.007)	(0.012)
		N	8762	64792	64792	3364	139101	139101
	Math		0.336***	0.277***	-0.035**	-0.155***	-0.032***	-0.013
			(0.036)	(0.013)	(0.015)	(0.051)	(0.007)	(0.010)
		N	9015	67926	67926	3331	145902	145902
High	ELA		0.236***	0.247***	0.082***	-0.009	0.050***	-
			(0.079)	(0.019)	(0.018)	(0.105)	(0.014)	
		N	2954	5011	5011	349	9441	
	Math		0.359***	0.305***	-0.019	-0.246*	0.039**	-
			(0.092)	(0.036)	(0.017)	(0.148)	(0.019)	
		N	2910	4916	4916	345	9401	
	Writing Topic		0.332***	0.272***	0.083***	-0.139	0.051***	-
			(0.090)	(0.029)	(0.028)	(0.204)	(0.020)	
		N	2920	4932	4932	348	9404	
	Writing Composition		0.298***	0.256***	0.072**	-0.137	0.038*	-
			(0.096)	(0.025)	(0.032)	(0.196)	(0.022)	
		N	2920	4932	4932	348	9404	

Table 13: Effects of School Characteristics

	Math				ELA			
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Urban	0.198***	0.072	0.008	-0.041	0.120***	0.062*	0.011	0.014
	(0.057)	(0.082)	(0.062)	(0.053)	(0.036)	(0.037)	(0.033)	(0.042)
Total minutes per day/100	-	0.154*		0.095	-	0.080*	-	0.055
		(0.090)		(0.078)		(0.042)		(0.038)
Minutes in relevant subject/100	-	0.203	-	0.207	-	0.023	-	0.007
		(0.211)		(0.168)		(0.075)		(0.068)
Per-pupil expenditure/1000	-	-0.002	-	-0.009	-	0.004	-	-0.001
		(0.014)		(0.010)		(0.008)		(0.009)
School is No Excuses	-	-	0.306***	0.231***	-	-	0.169***	0.117**
			(0.082)	(0.060)			(0.045)	(0.048)
Lottery	0.154**	0.086*	0.051	0.038	0.101**	0.055	0.047	0.033
	(0.069)	(0.050)	(0.052)	(0.041)	(0.043)	(0.035)	(0.036)	(0.033)
High School	0.039	0.078	0.035	0.087	0.069*	0.076*	0.062*	0.078*
	(0.071)	(0.065)	(0.052)	(0.057)	(0.036)	(0.040)	(0.032)	(0.040)
Constant	-0.131*	-0.835**	-0.064	-0.490	-0.085*	-0.445**	-0.047	-0.267
	(0.067)	(0.375)	(0.043)	(0.299)	(0.045)	(0.176)	(0.033)	(0.183)
N	30	28	30	28	30	28	30	28