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Right-sizing the Classroom

Making the Most of Great Teachers

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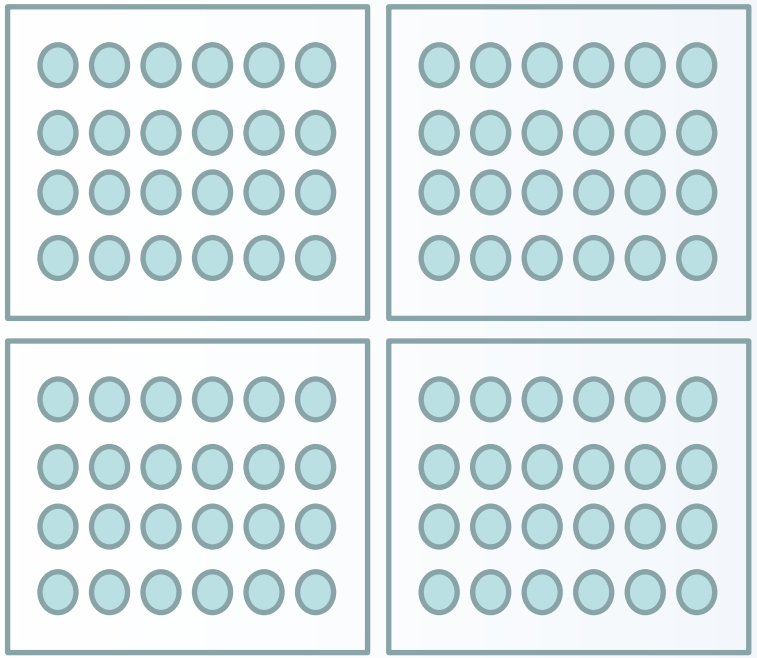
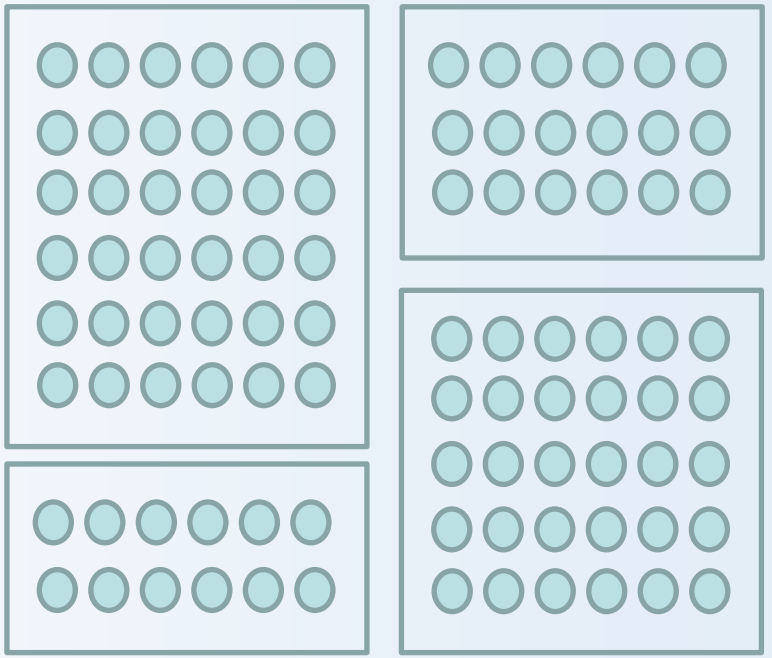
What if we tried playing to our strengths in schools?

Typical method



Class-size shifting



Summary of investigation and findings

- Research Design
  - » Data from North Carolina spanning four school years
  - » Estimate class size effects, value-added for teachers
  - » Use estimates to manipulate class assignments in a simulation

- Simulation Findings
  - » Learning gains can result from strategically manipulating class sizes
  - » Strategy results in greater access to effective teachers, though gaps persist
  - » In 8th grade benefits far outweigh plausible costs; 5th grade less decisive

Given what we know, the status quo cannot be optimal

- An effective teacher can impact a variety of important student outcomes
- Yet, teacher productivity varies considerably, both within and across schools

If teachers make such a difference and vary so much—

why are students equally assigned across all teachers?

Prior research favors teachers over class size

Teacher Quality

- Large impacts on students across multiple contexts
  - » Significant results across subjects and grades, though sizes vary
- Good teacher = extra ¼ to ½ year of learning

Class Size

- Small impacts, that are near zero in some contexts
  - » Largest in lower grades, initial exposure
- Equivalent impact of 10 to 20 student reduction in class size

Sources: Hanushek and Rivkin, 2010; Nye, et al., 2004; Whitehurst and Chingos, 2011.

This proposed strategy is not new

- Secretary Duncan, Bill Gates, and others have promoted it
- Underlying objective in Public Impact's *Opportunity Culture* initiative; class-size shifting is one of their many models
- Prior research studies have investigated this interplay, though not as directly as I do here
  - » Woessman and West, 2006; Barrett and Toma, 2013

Intuition behind class size shifting

- Reallocate more students into strongest teachers' classes away from weakest teachers
  - » Exposes more students to excellent teaching, fewer to weak teachers
- Only in rare occasions is equal class sizes optimal, given that we expect differences in performance
  - » Could be based on prior value-added performance, formal evaluation scores, or experience
- No requirement that all teachers are assigned students

Data

- North Carolina student-teacher linked administrative data
- Grades 5 and 8; Math, Reading, and Science
- Four school years:
  - 2007-08 through 2009-10 – inform expectations of teacher performance, other parameters for the simulation
  - 2010-11 – target year
- Focus specifically on school where students can be reallocated across teachers

Simulation Methods

1. Use first three years of data to estimate key parameters
    1. *Estimated coefficients on class size, classroom composition, experience*
    2. *Estimate teacher value-added based on averaged gains*

2. Use target year of data to generate results
    1. *Observed assignment of class sizes across teachers in NC*
    2. *Simulate data where students are randomly sorted and assigned to teachers based on prior effectiveness*

Outcome measures

1. Mean change in student learning
    - » Simulated based on *expectations* less actual based on *observed* data
2. Proportion of students assigned to top-quartile teachers
3. Proportion of FRL students assigned to top-quartile teachers

Target year current assignments

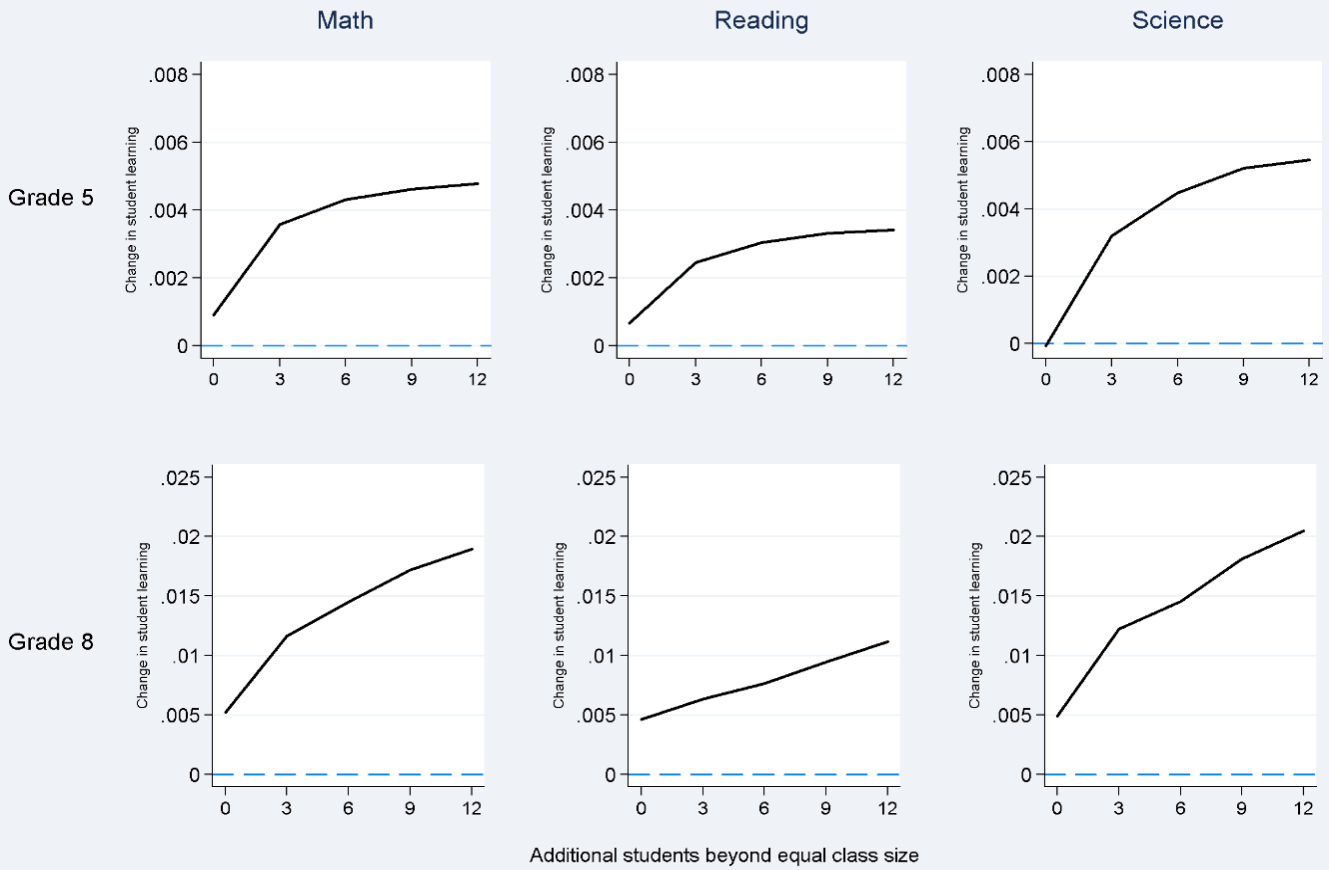
Table 3. Snapshot of Observed Class Size Assignment in North Carolina						
	Grade 5			Grade 8		
	Math	Reading	Science	Math	Reading	Science
Average class-size deviation within school	2.738	3.073	1.743	5.587	5.689	3.816
Within-school correlation of expected teacher performance and class size	0.045	0.086	0.050	0.022	0.012	0.025

Gap in Access Apparent in Data

Table 3. Snapshot of Observed Class Size Assignment in North Carolina						
	Grade 5			Grade 8		
	Math	Reading	Science	Math	Reading	Science
Proportion of students assigned to top-quartile teachers	0.258	0.287	0.237	0.251	0.244	0.254
Proportion of FRL students assigned to top-quartile teachers	0.235	0.260	0.217	0.232	0.243	0.226

Note – Strategically assigning students only remediates within-school gaps, not across-school gaps

Students Gain in Simulated Classrooms

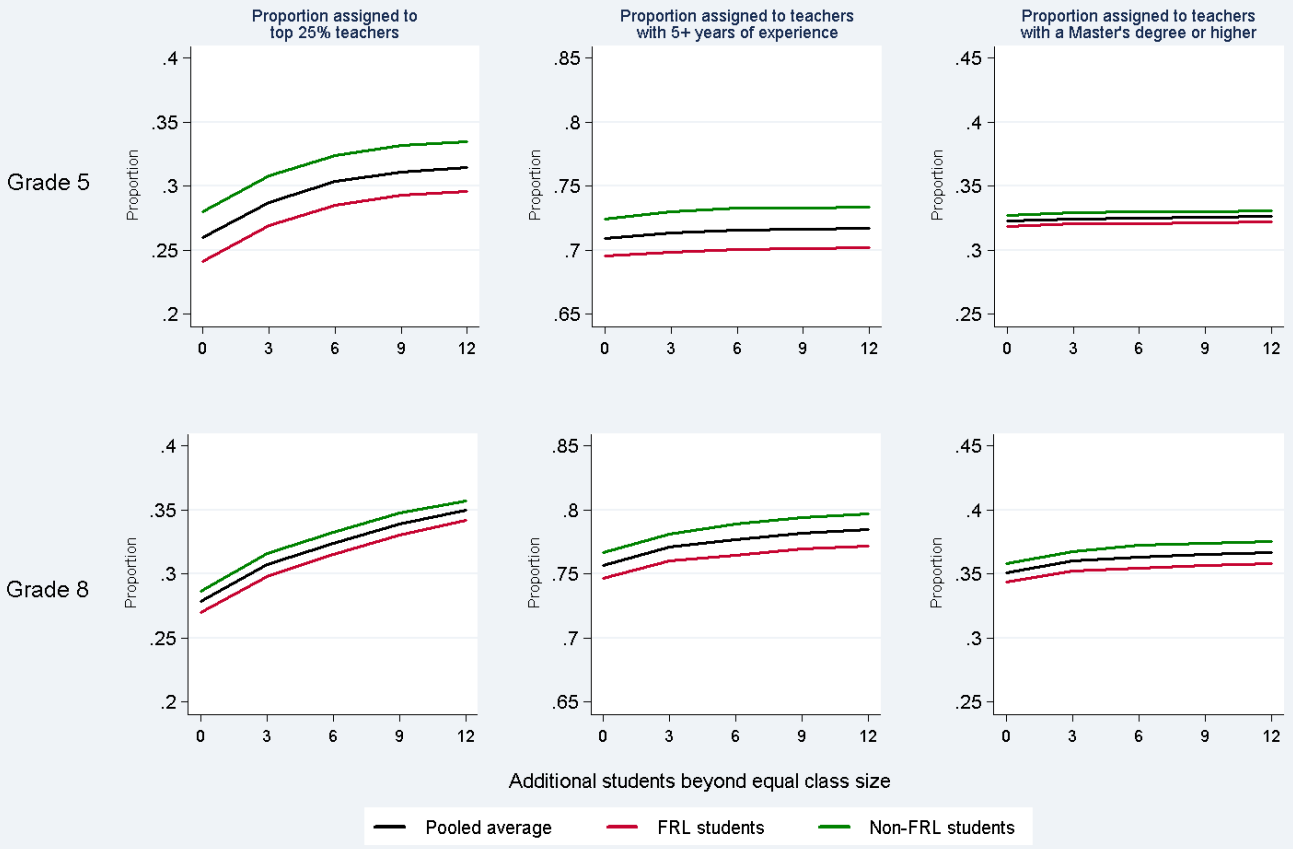


Additional students beyond equal class size on the x-axis is determined separately within each grade and school, so total class size for the largest classes may vary across the sample.
Changes in student learning on the y-axis is measured in student standard deviation units, and averaged across all students in schools and classrooms where class-size shifting is possible.

Results are particularly strong in 8th grade

- Moving 6 students is nearly 2 weeks in 8th grade math and science
  - » Essentially equivalent to current levels of class size deviations observed
  - » Equivalent to removing bottom 5% of teachers, without removing them!
- Maximum gains for 5th grade are roughly equal to 2 days
- Why the difference?
  - » Self-contained vs. single-subject assignments
  - » Past performance more reliable predictor in 8th grade

Access Gaps Still Persist



Additional students beyond equal class size on the x-axis is determined separately within each grade and school, so total class size for the largest classes may vary across the sample. The proportion measures describe the proportion of students assigned to teachers with the given characteristics. These proportions are calculated across all students, and on FRL and non-FRL student subgroups.

This is an inherently risky proposition

- Balancing known class-size effects against *expected* differences in teacher performance
- This pits known collective gains / losses for all students based on classroom assignments against expectations for individual gains
- In some cases, our expectations of teacher performance will not be realized

Table 4. The Interquartile Range of Simulated Learning Changes

	Additional Students	Math	Reading	Science
Grade 5	3	[-0.0075 - 0.0122]	[-0.0056 - 0.0110]	[-0.0072 - 0.0125]
	6	[-0.0089 - 0.0151]	[-0.0069 - 0.0133]	[-0.0092 - 0.0154]
	12	[-0.0099 - 0.0159]	[-0.0074 - 0.0141]	[-0.0101 - 0.0164]
Grade 8	3	[-0.0065 - 0.0260]	[-0.0088 - 0.0126]	[-0.0029 - 0.0234]
	6	[-0.0068 - 0.0326]	[-0.0102 - 0.0164]	[-0.0061 - 0.0310]
	12	[-0.0066 - 0.0405]	[-0.0153 - 0.0273]	[-0.0071 - 0.0455]

Note: Values in brackets represent the interquartile range (25th and 75th percentiles) of simulated changes in student learning averaged at the school-grade-subject level.

Robustness checks

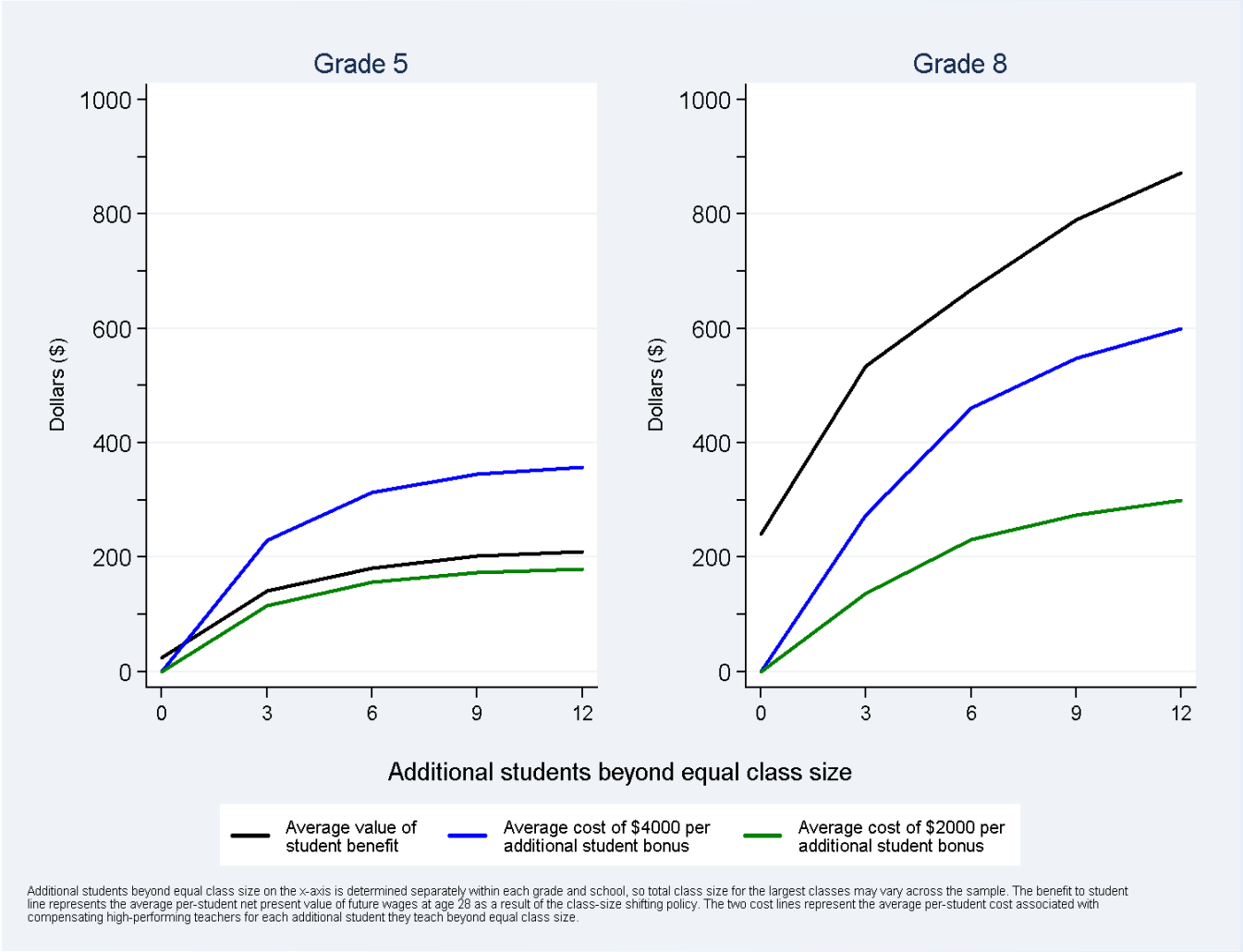
1. What if strategy was only implemented where differences between teachers were significant?
   - » Being more selective about implementation: 1/2 to 2/3 of schools
   - » Learning gains 20-30% larger than main results
   - » Less risk, greater reward
2. What if I'm underestimating class size effects?
   - » If so, then I'm also underestimating the variance of teacher quality
   - » Simulated learning gains from shifting students is even greater
   - » Though fewer students are sorted before optimality condition binds

Willingness and compensation

- Teacher / parent surveys suggest some support
  - 83% of teachers choose money over smaller classes
  - 73% of parents choose top teacher over smaller classes

- How to reward teachers, so this isn't a punishment?
  - Non-monetary – aides, status, removing out-of-classroom work
  - Monetary – bonuses using money from savings due to fewer remedial instructors, or lowering pay for leading smaller classes
  - Public Impact has framework on making their strategies low- or no-cost to schools after adoption is in place

Net value of learning gains



Additional students beyond equal class size on the x-axis is determined separately within each grade and school, so total class size for the largest classes may vary across the sample. The benefit to student line represents the average per-student net present value of future wages at age 28 as a result of the class-size shifting policy. The two cost lines represent the average per-student cost associated with compensating high-performing teachers for each additional student they teach beyond equal class size.

Other feasibility issues

- Making sure principals have data, can act in time
- Only focusing on quantity, not quality (tracking, students)
- Class size limits, both in CBAs and in laws
- Potentially disruptive to professional culture
- Beware of adverse responses among teachers
- Facilities would need to be more flexible

Conclusion

- **Efficient** – Class-size shifting can make educationally significant improvements in student learning, esp. 8th grade
  - » Caveats: assuming linear class size, performance invariant to mixing classes
- **No change in equity** – No relative improvement in student access to effective teachers
- Feasibility issues
  - » Laws, policies, collective bargaining agreements may need to change
  - » Could disrupt dynamic among workforce

Nevada class size issues

- Ongoing teacher shortages in Clark County
  - » Larger classes vs. long-term substitutes
- Legislation monitors class-size ratios at the district level
  - » School-level class-size ratio reported for elementary grades
  - » Variances must be requested for districts that exceed ratios, Washoe and Clark Counties have been over for years
- AB378 from 2015 contained language (though dropped in amendment process) about offering master teacher fund, offering more flexibility on class-size ratios

Recommendations

- Consider extra bonuses for teachers who take on larger classes; only assign excess to effective teachers
  - » Effective could be defined as evaluation scores, value-added estimates, novice vs. experienced
- Could consider low-cost paraprofessional support as a compensating differential for those with large class sizes
- Begin with experimenting with a few students over average
- Monitor teachers' attitudes, desire for more/fewer students, feelings about compensation, and changes in student outcomes

Estimated Parameters Based on Prior Years

Table 2. Estimated Class-size Effects and Teacher Value-added Variation						
	Grade 5			Grade 8		
	Math	Reading	Science	Math	Reading	Science
Class size	-0.0052***	-0.0020***	-0.0047***	-0.0035***	0.0000	-0.0024***
	(0.0005)	(0.0005)	(0.0005)	(0.0002)	(0.0003)	(0.0003)
Standard deviation of EB-adjusted teacher FE	0.1513	0.0801	0.1927	0.1333	0.0612	0.1500