Peer Effects From the Exit of High-Ability Students to Private and Charter Schools

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Overview

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2. A Model of Education Production
3. Dills 2005
4. Project STAR

Economic Motivation

- Education is a complex topic of study in economics
  - Endogeneity problems, especially in the areas of estimator bias, dependent variable choice, and reverse casuality are abundant
  - Most of the literature is centered around the analysis of the large-scale RCTs that have occurred around the world
- Within the context of education, there exist significant spillover effects that occur as a direct result of education
  - Examples include increased civic engagement, reduced crime, and increased peer-productivity
- Studying the mechanisms through which student outcomes may be maximized or diminished has significant policy consequences

A Model of Education Production

- Education can be modeled via a production function, similar to those you may have dealt with in Microeconomics
- The basic idea is the following: $T = f(A, Q, O, U, X)$ where:
  - T: is a measure of student achievement, mainly test scores
  - A: is a measure of student ability (high or low)
  - Q: is a measure of teacher quality (high or low)
  - O: are student, teacher, and school-level observable characteristics (age, gender, household income, etc.)
  - U: are unobserved student characteristics
  - X: are unobserved teacher characteristics
- One could more represent this at different levels utilizing subscripts i (student), j (grade), k (school)

A Model of Education Production (cont.)

Basic Education Production

$$T = \alpha_0 + \alpha_1 A + \alpha_2 Q + \alpha_3 O + \alpha_4 U + \alpha_5 X + \alpha_6 AQ + \mu$$

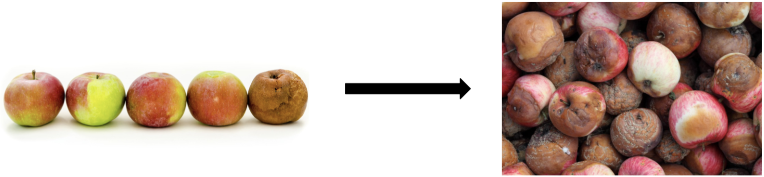
- Researchers have identified that observable and sometimes exogenous inputs (e.g. class size, teacher experience, teacher education, etc.) have little effect on student outcomes (Hanushek 2008)
- Others theorize that production is best modeled through analyzing disruption and the trade off between disruptive peers and smaller class sizes (Lazear 2001)
- Much of the current literature is centered around tracking, measuring, and estimating the effect of unobservables
- Chief among these unobserved characteristics are **peer effects**

Peer Effects

- What are **peer effects**?
- Broadly, peer effects are observed in many settings (workplaces, schools, sports, etc.)
- Peer effects describe any mechanism through which the behavior, actions, preferences, backgrounds, etc. of peers affect others

Peer Effects (cont.)

- What do **peer effects** look like within the context of education?
- Two main examples: Positive and Negative
  - Best understood through disruption and positive learning spillovers
  - "One bad apple spoils the bunch"



Peer Effects in Private Schools

- Education is often characterized as a **public good**
  - This means it satisfies two conditions: non-excludability and non-rivalry
  - Essentially, individuals cannot be excluded from the public school system, and if one student is in school it does not reduce the availability of education to others
- Private schools break these conditions by introducing rationing through two channels
  - Tuition Rationing
  - **Cream-Skimming**

Peer Effects in Private Schools (cont.)

- In particular, I'm interested in the spillover effects of **Cream-Skimming** by private and charter schools
- If private schools provide a channel through which richer, high-ability students are able to exit from public schools does this introduce negative peer effects on the "lower-ability" public school peers these students left behind?
- *"Does cream-skimming curdle the milk?"* (Dills 2004)

Dills 2005 – Overview

- Dills utilizes the entry of a magnet school as a potentially exogenous source of differences in peer quality to estimate peer effects
  - Key here is that since the magnet school selects high ability students from throughout the school district, the quality of peers in public schools changes as a result
  - Dills believes this natural experiment minimizes selection bias
- Utilizes a comparison of percentage scoring in the top and bottom quartiles of a standardized test before and after the introduction of the magnet school

Dills 2005 – Overview (cont.)

- Main result indicates that when high ability peers leave, low-scoring students are affected negatively
  - "After adjusting for the scores of the leavers, if an additional 1% of the high ability students leave a school, there is a one percentage point increase in the percentage of remaining students scoring in the bottom national quartile and a one-half of a percentage point decrease in the percentage of remaining students scoring in the top national quartile" (20).

Data

- In 1985, Thomas Jefferson High School for Science and Technology, a magnet school for high-achieving students (top 2% of entering high school freshmen in country) in Fairfax County, VA is opened
- Covariates for student observables are limited, but utilizes % scoring in each national quartile for high schools in surrounding area (after student entry)
- 11th grade standardized test data (SRA, TAP)
  - Finds that average scores in public schools are generally reduced due to magnet school entry (provides evidence of cream-skimming)
  - This drop is perhaps due to multiple factors including the transition from the SRA to the TAP between the '87-'88 school years
- Dills corrects school-level data for population changes due to magnet entry

Data (cont.)

Table 1
Descriptive statistics

Variable	Classes of 1987 and 1988	Classes of 1989–1992
	Mean (SD)	Mean (SD)
Regular high schools		
Eleventh grade test scores		
Mean national percentile score	77.31 (7.06)	71.86 (7.95)
% of students scoring in the bottom quartile	6.03 (3.69)	8.66 (4.61)
% of students scoring in the top quartile	55.58(10.36)	49.52 (10.96)
Eighth grade test scores		
Mean national percentile score	77.33 (6.20)	75.35 (7.11)
% of students scoring in the bottom quartile	3.41 (2.33)	4.32 (3.51)
% of students scoring in the top quartile	58.53 (10.29)	54.73 (11.54)
Magnet school		
Eleventh grade test scores		
Mean national percentile score		97.25 (0.50)
% of students scoring in the bottom quartile		0.05 (0.10)
% of students scoring in the top quartile		99.25 (0.58)
Average % of students attending magnet school		3.40 (1.62)

Empirical Strategy

- Utilizes OLS with instrumentation for school-specific policy to correct for the effect of high-ability students leaving decreasing the average test score ("school-specific changes in cohort quality")
- Also uses diff-in-diff to measure changes of school-level scores over time, controlling for the quality of freshmen who enter

Similarly, 11th grade test scores are a function of the school effect, s_j^{11}, the cohort effect, c_t^{11}, the school/cohort effect, $\underline{sc}_{jt}^{11}$, and the individual characteristics, ε_{ijt}^{11}. They are also a function of the percentage of students from each school/cohort that leave the school to attend the magnet school, L_{jt}:

$$X_{ijt}^{11} = g(s_j^{11}, c_j^{11}, \underline{sc}_{jt}^{11}, L_{jt}) + \varepsilon_{ijt}^{11}. \tag{2}$$

- Individual i, school j, year t

Empirical Strategy (cont.)

- Regresses on percent of students in top or bottom quartile after exit to determine peer effects on each ability group
- Fixed effects correct for school and cohort-level variation

Fixed Effects

- $\mathbf{s_j^{11}}$ represents school *j*'s fixed school quality (i.e. allows for better schools to improve scores)
- $\mathbf{c_j^{11}}$ represents time-invariant, county-wide variation such as weather, school district policy, etc.
- $\mathbf{sc_{jt}^{11}}$ represents school-cohort "shocks to achievement" (i.e. one crop of students is better than another) (20).

Empirical Strategy (cont.)

- Here, we are interested in $\alpha_1, \tilde{\alpha_1}$ which is the effect of HA departure on students left behind
- If all students benefit from HA peers, α_1 is negative and $\tilde{\alpha_1}$ is positive

$$\text{top}_{jt}^{11} = \alpha_0 + s_j^{11} + c_j^{11} + \underline{sc}_{jt}^{11} + \alpha_1 L_{jt}. \tag{5}$$

$$\text{bottom}_{jt}^{11} = \tilde{\alpha}_0 + \tilde{s}_j^{11} + \tilde{c}_j^{11} + \tilde{s}c_{jt}^{11} + \tilde{\alpha}_1 L_{jt}. \tag{5'}$$

Results

- OLS/IV Estimates find negative peer-effects from student exit
- Diff-in-diff finds same results, though magnitudes smaller

Table 2
Ordinary least squares and instrumental variables estimates of peer effects

	% scoring in bottom quartile		% scoring in top quartile	
	OLS	IV[a]	OLS	IV[a]
% leaving$_t$	0.155 (0.169)	0.702 (0.316)	0.036 (0.273)	−0.742 (0.524)
R^2	0.87	0.86	0.94	0.93
Number of observations	108	108	108	108
F-test (,)	8.04	33.33	11.80	81.61
Prob $>F$	0.0000	0.0000	0.0000	0.0000

Robust standard errors in parentheses. Year dummies and school fixed effects are included and jointly significant. The percentage of students scoring in each quartile is corrected for the change in population occurring with the loss of the magnet school students, assuming that all magnet school students score in the top national quartile. Thus, coefficients should be interpreted as peer effects.

[a]School-specific indicator variables for the magnet school policy are used to instrument for the percent leaving.

Strengths & Weaknesses

- Introduction of Magnet corrects for some degree of sorting (natural experiment)
- Teacher transfer to the Magnet, limited student tracking, and lack of covariates harms results
- Class-size effects may be confounding
- Admissions policy may bias peer effects (i.e. county "smooths" number of students entering TJHS from each middle school)
- Does not correct for demographic changes in student body

Project STAR

- Project STAR was an experiment undertaken in Tennessee, where each student in the 1985 kindergarten class in participating public schools was randomly assigned to one of three classes:
  - Small class of 13–17 students, regular-sized class of 22–25, or a regular-sized class with teachers aide
- The experiment lasted through the 3rd grade. New students were also re-randomized into the experiment
- Has robust observable controls (students tested every year) and randomization has been shown to be successful
- There was differential attrition in the experiment (i.e. attrition changed based on class type)

Project STAR (cont.)

- For my purposes, I would perhaps explore effect of peers who left the public school system in year t on students in year $t + 1$ in same class
- However, it is hard to tell which students left public school system – Rohlfs & Zilora in 2013 estimate this share through looking at students who didn't have public school test score data after 4th grade and weren't tracked in STAR
- If I was able to back out the distribution of students who left, could tell if it was, in fact, high ability peers
    - Perhaps generate a sample of peers who match characteristics of leaving through a logit model and simulate the effect of these peers leaving

Rohlfs and Zilhora: Selected Figures

Table 1: Sample means for Project STAR students and classes by class type, kindergarten entry cohort

	(1)	(2)	(3)	(4)	(5)
	Small	**Regular**	**Regular/ aide**	**Joint *p*-value**	**Within-school joint *p*-value**
Free lunch	0.474	0.483	0.508	0.131	0.425
White/Asian student	0.682	0.678	0.655	0.375	0.398
Age on October 1, 1985	5.058	5.050	5.054	0.687	0.619
Class size in kindergarten	15.08	22.32	22.67	0.000**	0.000**
Urban school	0.295	0.292	0.308	0.721	
White/Asian teacher	0.862	0.817	0.842	0.663	0.564
Teacher has postgraduate degree	0.305	0.384	0.374	0.396	0.338
Teacher experience	8.993	9.100	9.893	0.494	0.365
Special education in kindergarten	0.036	0.032	0.028	0.480	0.619
Special instruction in kindergarten	0.057	0.042	0.047	0.505	0.601
Days present in kindergarten	156.0	156.8	155.6	0.604	0.331
Days absent in kindergarten	10.00	10.52	10.95	0.059*	0.034**
Missing data	0.010	0.025	0.025	0.000**	0.214
Observations (Nonmissing)	1,788	2,028	2,058	5,874	5,874
Observations (Total)	1,806	2,079	2,111	5,996	5,996
Classrooms	121	93	93	307	307
Schools	75	74	75	75	75

Rohlfs and Zilhora: Selected Figures

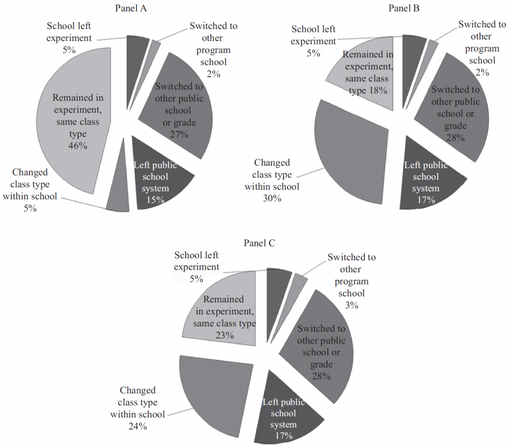
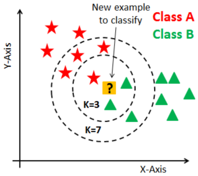


Figure 2: Status in third grade by initial class assignment in Project STAR, kindergarten entry cohort. Panel A: initially in small class, Panel B: initially in regular class, and Panel C: initially in regular class with aide

Notes: Students are counted as having left the public school system if they do not appear in Project STAR in third grade and TCAP scores are not available for them in 1990 (the year in which most students from the cohort were in fourth grade). Additional details in the text.

Empirical Strategy 1

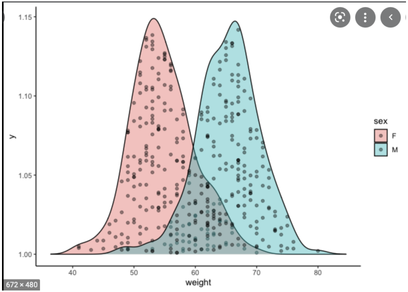
- **Main issue:** Of the students that left the public school system, how may I classify them as private school students?
- Workaround (Path 1):
  - Using control data and data on private school students, attempt to find a measure of the "typical private school student"
    - Utilize a classification algorithm (k-nearest neighbors) with validation tests (k-fold cross validation) to bin exiting students as private school students



  - Fit a regression analyzing the lagged-achievement peer effect of these students leaving on their peers

Empirical Strategy 2

- Workaround (Path 2):
  - Using control data and data on private school students, attempt to find a measure of the "typical private school student"
  - Utilize a classification algorithm (k-nearest neighbors) with validation tests (k-fold cross validation) to find the *probability* that each student looks like a private school student



Empirical Strategy 2

- Workaround (Path 2 – cont.):
  - Utilizing this distribution take multiple weighted or random samples of students leaving, treat these students as having gone to a private school and isolate the effect of these students
  - I will then have a distribution of the range of the peer effects on other students – allowing me to create an upper and lower bound of the effect over many combinations of students leaving

Referenes

- Dills, Angela. (2005). Does cream-skimming curdle the milk? A study of peer effects. Economics of Education Review. 24. 19-28. 10.1016/j.econedurev.2004.01.002.
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