Peer Effects in Middle School Students' Test Scores with Accounting for Individual Heterogeneity

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Peer Effects in Middle School Students' Test Scores with Accounting for Individual Heterogeneity

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Abstract

We estimate economically significant peer effects in test scores:

- In 8th graders in a typical county school district in U.S. state of Georgia
- Utilize variation in test scores across different subjects within the individual student to account for individual unobserved heterogeneity

Research Question & Context

- *Peer effect* (or *endogenous social effect*) in early education can play crucial role in tracking, education finance issues such as school vouchers, busing and desegregation policies
- **Peer effects in test scores** can be crucial in policy formulation: Suppose a policy is aimed at improving the test scores of underperforming students within a group. If the scores of these students improve, they raise the average test score of the group and thereby exerts a positive effect on everyone's test scores in the group, and so on … (multiplier).
- Peer effects difficult to identify and quantify. Existing approaches are
  Controlled experiments (expensive)
  Valid instruments (difficult to find)
- Our approach is intuitive and easy to implement
  Only requires test score in multiple subjects
  No prohibitive technical skills required

Social Effects

Why students in a group may behave similarly?

- Students may act similarly because they are influenced by their **peers' behaviors** (*peer effects* with possible social multipliers)
- Students may attain similar outcomes because they are influenced by their **peers' characteristics** (*exogenous* or *contextual* effects)
- Students in a group may exhibit similar outcomes because they all **share the same characteristics** (*correlated* effects)

Obstacles in Identification of Peer Effects

Regress individual test scores on group average test scores and find a positive significant coefficient: not necessarily peer effect

- Correlation between students' outcomes may arise from self-selection into groups and common unobserved shocks
- R*eflection problem* (Manski 1993): Simultaneity between individual & peer outcomes may prevent separating some contextual effects – e.g., the influence of peers' unobserved characteristics – from the peer effect
- There may be heterogeneity in the impact of the individual on her peers

Data

A typical county school district in the U.S. state of Georgia

There are 4 middle schools in the district

Test scores are available for each school for each of the 4 years: 2006-2009

Group = 8th graders in a certain school in a certain year
16 distinct groups

Strength of data set: test score available for 98.6 percent of the students

Sample 1 (N=2732)	Mean	SD	Min	Max
School-year group	8.27	4.64	1	16
Group size	175.06	29.76	134.00	253.00
Math z-score	-0.28	0.97	-3.05	5.74
Reading z-score	-0.30	0.76	-2.68	3.19
Science z-score	-0.28	0.87	-3.01	4.12
Social studies z-score	-0.10	1.06	-2.76	4.39

Comparing with Existing Literature

Latest and most updated model: Boucher et al. (2012) based on Lee (2007)

- Identification in this model achieved when:
  Individual is excluded from the peer average
  There are sufficient number of groups of different sizes
  The average group size small relative to number of groups in sample
- Our sample has large group sizes:
  Excluding the individual from the peer group creates little distinction between the individual's peer average and the overall group average
- In this kind of a sample:
  peer average of the outcome may not be identified in the presence of average peer characteristics or group fixed effects

Specification

M_{ri} is student i's group of peers, of size $m_r - 1$. Consider regression,

$$y_{rik} = \theta_{ri} + \eta_r + \pi_k + \beta\, \bar{y}_{rik} + \varepsilon_{rik},$$

y_{rik} = score on test k obtained by student i of group r

k =math, reading, science, social studies

$\bar{y}_{rik} = \left(\sum_{j \in M_{ri}} y_{rj,k}\right) / (m_r - 1)$

θ_{ri} individual fixed effect (FE)

η_r group fixed effect

π_k other fixed effects (school FE, year FE, test subject FE)

- Individual FE encapsulates
  Observed and unobserved time-invariant individual characteristics
  Sources of observed and unobserved exogenous effects
  (peer groups individual specific & invariant across four test scores)

Results

Estimation of Peer Effects

	(1)	(2)	(3)
Group average test score	**0.983*** **	**0.982*** **	**0.982*** **
Observations	10,928	10,928	10,928
Number of students	2732	2732	2732
Log likelihood	-5791.785	-5751.528	-5678.756
Individual FE	yes	yes	yes
Group FE	no	no	yes
Subject FE	no	yes	yes
School FE	no	yes	yes
Year FE	no	yes	yes

1 standard deviation increase in group average raises individual test score by 37% of 1 standard deviation

Robustness

For 7 of the 16 groups we have additional information about the characteristics of the students (Sample 2)

Correlations: Test Scores and Individual Characteristics (Sample 2)

	Test z-scores			
	Math	Reading	Science	Social studies
Girl	0.04	0.08	-0.02	0.02
Black	-0.28	-0.25	-0.35	-0.25
Free meal recipient	-0.29	-0.29	-0.33	-0.30
Number of disciplines in the 7th grade	-0.28	-0.28	-0.29	-0.25
Number of disciplines in the 8th grade	-0.28	-0.26	-0.27	-0.26
Number of absences in the 7th grade	-0.02	-0.01	-0.03	0.09

Estimation of Peer Effects (Sample 2)

	(1)	(2)	(3)
Group average test score	**0.973*** **	**0.922*** **	**0.922*** **
Observations	4,532	4,532	4,532
Number of students	1133	1133	1133
Log likelihood	-2297.355	-2234.943	-2233.655
Individual FE	yes	yes	yes
Group FE	no	no	yes
Subject FE	no	yes	yes
School FE	no	yes	yes
Year FE	no	yes	yes

1 standard deviation increase in group average raises individual test score by 31% of 1 standard deviation

Concluding Remark

Our approach can offer local officials and policy-makers a quick, inexpensive and easy-to-calculate tool to evaluate peer effects in local school districts.