

Lecture 8 – Equilibrium: Peer Effects

The Puzzle

Researchers studying the Air Force Academy found that low-ability freshmen did better when their squadron had more high-ability peers. The Academy acted on it: new squadrons were built to put low-ability students with high-ability peers. Those students then did *worse* than before. The finding was real. The policy built on it failed. Why?

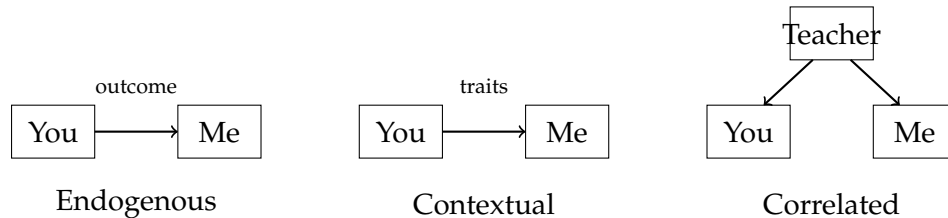
Three Reasons Classmates Look Alike

Everyone believes peers matter. The hard part is showing that is true. Manski gave three reasons two students in a room can have similar outcomes.

Endogenous: my outcome depends on *your outcome*. I learn more when my classmates learn more.

Contextual: my outcome depends on *your characteristics*. I learn more when my classmates come in better prepared, or better behaved.

Correlated: we look alike because we *share something else*. Same teacher, same neighborhood, same reason for picking this school.



Only the first two are peer effects. The third is everything else the students in a room have in common.

The three carry different policy advice. Suppose a district tutors a random half of a class. Which story predicts the untutored half gains too? – *Only the endogenous one. Contextual effects run off characteristics the tutoring didn't change, and correlated effects aren't caused by peers at all.*

Why This Is Hard to Measure

This is hard to measure.

Sorting. Students pick their schools, their friends, and often their classes, and parents pick their neighborhoods. Strong students cluster with strong students because they chose to, not because of anything that happens in the room. This is

the correlated-effects problem, and it is selection all over again: the comparison you want is not the comparison you have.

Reflection. Say Ann and Ben are roommates and both have high GPAs. Did Ann raise Ben, or Ben raise Ann? Ann's GPA sits on the right-hand side of Ben's equation and Ben's sits on the right-hand side of Ann's. The data cannot separate them, because each is both cause and effect. Manski called this the **reflection problem**: you see the mirror move with the person and cannot tell which one is leading.

Does randomization fix it? – *It fixes sorting, not reflection.* And not even all of sorting: randomly assign students to classrooms and they still share a teacher, a room, and a time of day. A correlated effect survives the lottery.

So good work on peer effects does one of three things: find a setting where *groups* are assigned at random (roommates, squadrons, barracks); use a peer trait that cannot be a reflection of your own outcome (a classmate's pre-existing characteristic, a classmate's exposure to domestic violence, the share of your cohort that is female); or impose a model that says exactly how peers operate, and then defend its assumptions.

One Model of Peer Effects: Lazear

"Peers matter" is not a model. Lazear asked *through what*, and gave one answer: **disruption**. Of course this is not the only answer, but it's an interesting starting point.

Let p be the chance that any one student is *not* disrupting at a given moment. The class is learning only if nobody is disrupting:

$$\text{Chance the class is learning} = p \times p \times \cdots \times p = p^n \quad \text{in a class of } n.$$

With well-behaved students, $p = 0.98$: a class of 10 is learning 82% of the time, a class of 30, 55%. Drop to $p = 0.95$ and a class of 30 is learning 21% of the time. *One* harder student pulls the product down for all n of them.

A teacher costs W , and bigger classes mean fewer teachers. Per student, learning is p^n and the teacher costs W/n . Put a dollar value V on a unit of learning, and the school picks the n that makes $Vp^n - W/n$ as large as possible. Take $V = \$10,000$ and $W = \$60,000$:

Class size n	$p = 0.95$		$p = 0.98$		Cost W/n
	Benefit Vp^n	Net	Benefit Vp^n	Net	
10	\$5,987	–\$13	\$8,171	\$2,171	\$6,000
15	\$4,633	\$633	\$7,386	\$3,386	\$4,000
20	\$3,585	\$585	\$6,676	\$3,676	\$3,000
25	\$2,774	\$374	\$6,035	\$3,635	\$2,400
30	\$2,146	\$146	\$5,455	\$3,455	\$2,000

This is marginal analysis with peer-effects. Read the columns:

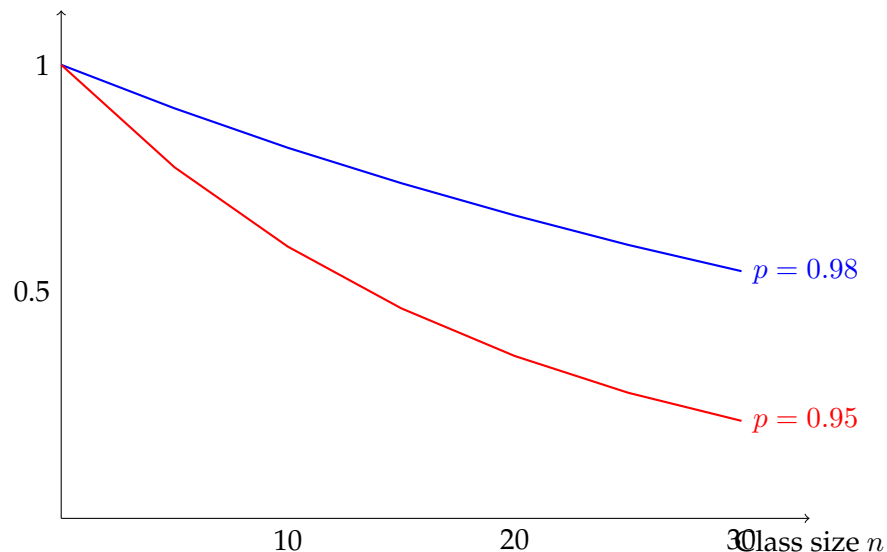
The best class size at $p = 0.95$ is 15. At $p = 0.98$ it is 20. Better-behaved students belong in bigger classes.

Class size matters most where p is low. Going from 15 to 30 costs the 0.95 class more than half its learning time and the 0.98 class about a quarter.

Raise the teacher wage and optimal classes grow. Double W in the $p = 0.95$ column and the best size moves from 15 out past 30. So where should class-size effects be biggest, preschool or college? – Preschool: lower p , cheaper teachers.

A good teacher may be raising p rather than teaching better. Moving p from 0.97 to 0.99 buys a lot of learning. Much of what we measure as teacher quality may be classroom management.

Share of time the class is learning



A three-point difference in behavior is nothing in a class of 5 and enormous in a class of 30.

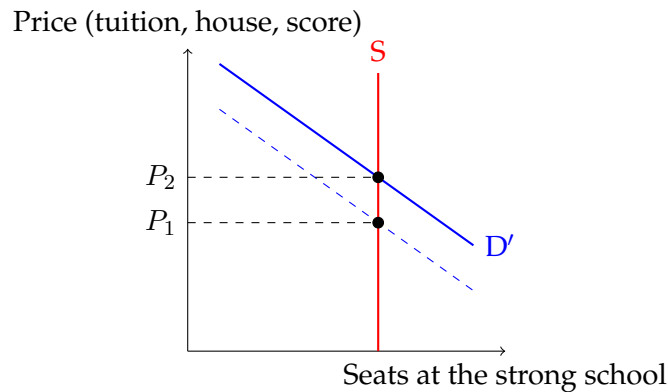
General Equilibrium: Why the Policy Failed

Supply and demand clears one market at a time and holds the rest of the world still. That is **partial equilibrium**. Most peer effect estimates are partial equilibrium: *if this student's classmates had been stronger, and nothing else had changed, how would she have done?* **General equilibrium** asks what happens when everything is free to adjust at once, which is the situation many policies actually create.

Quantities. Good peers are in fixed supply. A reassignment policy moves them rather than making more, so whatever one classroom gains another loses. Take the

simplest peer model, in which your score depends on the average ability of your classmates — call it “linear in means.” Under it the gains and losses cancel exactly: rearranging students is pure redistribution, and all a district decides is who gets the good peers. An estimate of what a strong classmate does for you is silent about the room she came from.

Prices. Seats next to good peers are scarce, fixed in number, and widely known to be valuable. Supply and demand says what has to happen next.



Whoever ends up in those seats has paid for them: as private tuition, as the rent inside an attendance zone, or, where the price is held down, as a test score, a place on a waitlist, or a parent with the time to work the lottery. Economists call this **capitalization** — the value of the peer group is absorbed into the price of getting near it. Every one of those rationing devices sorts on family resources or family attention, so the market does not merely price the peer effect, it manufactures the correlated effect from the start of this lecture. A school full of families who paid to get in will look good whether or not it is any good.

Behavior. Back to the Academy. Carrell, Sacerdote and West estimated peer effects from squadrons students had been assigned to at random, then used those estimates to build squadrons designed to lift the lowest-ability students. Inside the designed squadrons the students re-sorted: the low-ability students formed their own study and friendship groups, the high-ability students formed theirs, and the contact the design was counting on never took place. The targeted students did worse than under random assignment.

Nothing was wrong with the first estimate. It described behavior *under random assignment*, and the policy's first act was to abolish random assignment. Economists call this the **Lucas critique**: a relationship estimated under one set of rules need not hold once the rules change. Peer groups, which people choose, are about the least durable thing you could build a policy on.

So before scaling any peer finding, ask what the estimate held fixed and whether

the policy will hold it fixed too. This one held fixed the supply of good peers, the price of a seat near them, and students' freedom to choose their own friends. The policy changed the third and never had a chance.

How would you have designed it instead? – *Smaller changes, groups people cannot opt out of, or trying the design on a random subset first. The last one is the real answer: the Academy ran a policy at scale on the strength of a regression.*

Beyond the Classroom

A principal wants to spread the strongest readers evenly across sections “so everyone benefits.” Under which model does that raise total learning? Under which does it not?

A state publishes school ratings. Who moves, and what happens to the schools at the bottom?

A college advertises a dorm reserved for honors students. What has it just sold, and at what price?

Your own schooling: name one peer effect you experienced. Which of Manski's three was it? Could you have told them apart at the time?

Wrapping Up

Three stories fit the same data: endogenous (your outcome), contextual (your traits), correlated (something we share). Only the first two are peer effects.

Reflection means that even under random assignment you cannot untangle who influenced whom from outcomes alone.

Lazear supplies a mechanism: learning time is p^n . Better behavior justifies bigger classes, class size bites hardest where behavior is worst, and grouping by p pays because it lets class size differ.

Peers are in fixed supply. Reassignment moves good peers rather than making more, so under linear in means it is pure redistribution: the policy settles who gets them, not how much learning there is.

Capitalization: the value of a good peer group is absorbed into tuition, rents and admissions cutoffs, and every rationing device sorts on family resources. The market creates the correlated-effects problem.

Partial vs. general equilibrium: an estimate holds the world fixed, a policy moves it. Ask what was held fixed — quantities, prices, behavior — and whether the policy will hold it fixed too.

The Lucas critique: a relationship estimated under one set of rules need not survive a change in the rules. Peer groups, which people choose, break especially easily.

Practice Problems

1. Classify each as endogenous, contextual, or correlated, and say what evidence would separate it from the others.
 - (a) Students in classes with more disruptive classmates score lower.
 - (b) A student's test score rises when her classmates' scores rise.
 - (c) Students at a magnet school outscore students at the zoned school.
 - (d) Girls in cohorts with a higher share of girls score higher in math.
 - (e) Roommates have similar GPAs.
2. A district randomly assigns students to classrooms and finds that having more high-scoring classmates raises your score.
 - (a) Which of Manski's three does the randomization rule out? Which survive?
 - (b) Why can't you tell from this whether your classmate raised you or you raised your classmate?
 - (c) The district reassigns every student to maximize the gain to the bottom quartile. Give two reasons the measured effect may not show up.
3. A state publishes school ratings. One elementary school is rated far above the rest. Its seats are fixed.
 - (a) Draw the market for seats before and after the ratings are published.
 - (b) What is the price, and who pays it?
 - (c) A year later the school's scores are even higher. Does that show the school is causing the gains?
 - (d) What would you need in order to separate the school's effect from its students'?

Answer Key

1.

(a) Contextual: a classmate characteristic, not a classmate outcome. Separate it with variation in class composition the student did not choose.

(b) Endogenous — and the hardest to establish, because of reflection. You would want something that shifts your classmates' scores without touching yours, such as tutoring given to a random subset.

(c) Correlated, most likely. Families chose the magnet. Lotteried admission would separate it.

(d) Contextual. Cohort gender share is largely beyond a student's control, which is why this design gets used.

(e) Could be any of the three. Random roommate assignment removes the sorting, and still leaves reflection.

2.

(a) It rules out correlated effects that come from student sorting. It does not rule out correlated effects from the teacher, the room, or the period, and it does nothing about reflection.

(b) Your score sits on the right side of your classmate's equation and hers sits on the right side of yours. They are determined together, so the data show only that they move together.

(c) Students re-sort inside the new groups, so the intended exposure never happens (the Academy result); peers are in fixed supply, so whatever the bottom quartile gains, some other group loses; and the estimate came from random assignment, which the policy has just abolished.

3.

(a) Vertical supply at the number of seats. Demand shifts out when the ratings appear.

(b) The price rises, paid as house prices or rent inside the attendance zone. Seats are rationed by income rather than by lottery.

(c) No. Higher-scoring families moved in, so measured scores would rise even if the school did nothing. This is the correlated-effects problem showing up as a policy evaluation.

(d) Variation in attendance that is not a family's choice: a lottery, a boundary change, or a comparison of students just inside and just outside the zone.