Peer Effects with Random Assignment: Results for Dartmouth Roommates

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- In Manski's paper, there has not been much explanation about the endogeneity of the reference group. This could be part of the Contextual effect (relationship between the individual's behavior and the exogenous characteristics of his/her reference group) or the endogeneity effect (individuals only form reference groups based on the similarity of the behavior).
- In this paper, the author uses a unique data on Dartmouth dormitory roommates to eliminate the possibility of endgeneity of peer group formation.
- The freshmen in Dartmouth are assigned randomly to rooms, thus rommates are selected randomly.
- There is peer effect of the roommate on the GPA, but only for the first year. Also, they find peer effects on social activities such as joining a fraternality.

Empirical Framework

Suppose that student i and j are randomly chosen to be roommates. Then,

$$GPA_i = \delta + \alpha(ACA_i + \mu_i) + \beta(ACA_j + \mu_j) + \gamma GPA_j + \epsilon_i \quad (1)$$
$$GPA_j = \delta + \alpha(ACA_j + \mu_j) + \beta(ACA_i + \mu_i) + \gamma GPA_i + \epsilon_j \quad (2)$$

ACA: academic index:
0.1*average SAT I + 0.1* average SAT II + rescaled highschool rank score.
Each factor is given one third weight.

Reduced Form Equation

$$\begin{aligned} GPA_i &= \frac{1}{1-\gamma^2}\left[(1+\gamma)\delta + (\alpha+\gamma\beta)ACA_i + (\beta+\gamma\alpha)ACA_j \right. \\ &+ \left. (\alpha+\gamma\beta)\mu_i + (\beta+\gamma\alpha)\mu_j + \gamma\epsilon_j + \epsilon_i\right] \end{aligned} \tag{3}$$

In coefficients:

$$GPA_i = \pi_0 + \pi_1 ACA_i + \pi_2 ACA_j + \eta_i$$

Estimate by OLS. Notice that ACA_j is randomly chosen, thus there is no endogeneity issue.

Recovering Structural Parameters

- We get the coefficient estimates

$$\pi_0 = \frac{1}{1-\gamma^2}(1+\gamma)\delta$$

$$\pi_1 = \frac{1}{1-\gamma^2}(\alpha+\gamma\beta)$$

and

$$\pi_1 = \frac{1}{1-\gamma^2}(\beta+\gamma\alpha)$$

- But we cannot recover the structural parameters α, β and γ, i.e. separately estimate contextual effect α, β and endogenous effect γ unless strong additional assumptions are imposed.

- Assumption: There is no measurement error in ability background. $\mu_i = \mu_j = 0$. Then,

$$Var(\eta_i) = \frac{1+\gamma^2}{(1-\gamma^2)^2}\sigma_\epsilon^2$$

$$Cov(\eta_i, \eta_j) = \frac{2\gamma\sigma_\epsilon^2}{1-\gamma^2}$$

Then, from those two equations, one can recover γ and σ_ϵ^2.

Estimation Results

Dependent variable: Freshman year GPA

	Reduced Form		Structural	
	Coef.	Std. Err	Parameter	t-stat
Mate freshman GPA	0.120	(0.039)	0.148	(1.64)
HS academic score	0.014	(0.0008)	0.014	(14.6)
Mate HS acad. score	-0.001	(0.001)	-0.003	(-1.3)
R Squared	0.24		0.21	
Sample Size	1589		849	

- Roommate's GPA positively and significantly affects own freshman GPA. Evidence of peer effects, either contextual or endogenous effect. Coefficient small in size.
- Own highschool academic score: positive and significant as well. But highschool academic score of rommates negative and insignificant.
- Strutural parameter of roommate's GPA is positive and significant: Positive and significant endogenous effect.
- Structural parameter of roommete's HS score is insignificant: There is no contextual effect with respect to roommate's HS score.

TABLE III
PEER EFFECTS IN ACADEMIC OUTCOMES

	(1) Fresh year GPA	(2) Fresh year GPA w/ dorm f.e.	(3) Senior year GPA	(4) Fresh year GPA	(5) Fresh year GPA	(6) Fresh year GPA	(7) Graduate late	(8) Econ major
Roommates' GPA	0.120**	0.068**	0.008					
	(0.039)	(0.029)	(0.026)					
HS academic score	0.014**	0.015**	0.013**				−0.0001	0.003**
(self)	(0.0008)	(0.0007)	(0.0009)				(0.0003)	(0.0006)
HS academic score	−0.001	−0.0003	0.0009				0.0003	−0.0001
(roommates')	(0.001)	(0.0009)	(0.001)				(0.0003)	(0.0006)
roommates' academic				0.016	0.014	0.017		
score bottom 25				(0.028)	(0.025)	(0.025)		
percent								
roommates' academic				0.060**	0.047*	0.043*		
score top 25 percent				(0.028)	(0.026)	(0.026)		
roommates' intention						0.082**		
to graduate w/honors						(0.037)		
(1–4)								
own academic score					−0.284**	−0.282**		
bottom 25 percent					(0.025)	(0.025)		

own academic score top 25 percent					0.174** (0.025)	0.175** (0.025)		
Roommate graduate late							0.008 (0.029)	
Roommate econ major								−0.018 (0.026)
Dummies for housing questions	yes	yes	yes	yes	yes	yes	yes	yes
F test of roommate background coefficient = 0				$F = 2.31$ $P = 0.10$	$F = 1.63$ $P = 0.20$	$F = 2.74$ P = 0.04		
R^2	.24	.38	.18	.05	.19	.19	.06	.07
N	1589	1589	1441	1589	1589	1589	1589	1589

Standard errors are in parentheses and are corrected for clustering at the room level. In cases with more than one roommate, roommate variables are averaged. ** = p-value < .05. * = p-value < .10.

Regression (1) is OLS of own GPA on roommate GPA and controls. If own and roommate academic indices are excluded, the coefficient on roommate GPA falls to .111, and the standard error falls to 0.037.

Regression (2) adds dorm fixed effects. The coefficient on roommate GPA falls, but remains significant. Regression (3) is OLS of own senior year GPA on freshman year roommates' senior year GPA. Senior year GPA includes all grades in final year and excludes grades from earlier years.

Regressions (4)–(6) are OLS of own GPA on own and roommate background. These regressions use dummies for own and roommate academic index are in the bottom 25 percent, middle 50 percent (excluded category), or top 25 percent of their respective distributions. Regression (4) shows that "roommate top 25 percent" is significant in predicting own GPA. The level of significance on "roommate top 25 percent" falls to .10 when two dummies for own academic index are added. (This is regression (5).) Regression (6) shows that roommate intention to graduate with honors also predicts own GPA. This variable is a self-assessed probability of graduating with honors and is coded as a 1, 2, 3, or 4 for the responses of no chance, very little chance, some chance, or a very good chance. Regression (6) also includes a dummy for "roommate intend to graduate with honors" missing. See text for more discussion of this variable.

Regressions (7) and (8) are probits of own "graduate late" and own "major choice = econ" on roommate graduate late and roommate major choice = econ. $\partial y/\partial x$ is shown.

- Correlated effect: To separte out the common shocks that could both affect the student and his/her roommates, add dormitory fixed effects. Reduced from coefficients of roommate GPA and own HS score still the same sign and significance but the magnitude of the GPA coefficient drops by half (difference insignificant).
- For senior year GPA, Roommate's GPA is insignificant, while own HS score is still positive and significant, with the same magnitude. Peer effect only has a short term effect, whereas own background has a long term effect on GPA.
- Nonlinearities: Top 25 percent student roommates benefit GPA modestly, and bottom 25 percent rommates do not have any effect.
- Interaction effect: Top 25 percent student roommates benefit top and bottom students. Bottom 25 percent student roommates do not hurt students compared to the middle 50 percent students.

	Roommate academic index		
Own index	Bottom 25%	Middle 50%	Top 25%
Bottom 25%	-0.331 (0.056)	-0.304 (0.035)	-0.160 (0.049)
Middle 50%	0.039 (0.034)	0	-0.019 (0.036)
Top 25%	0.146 (0.045)	0.159 (0.037)	0.243 (0.044)