Does Living Near Classmates Help Introductory Economics Students Get Better Grades?

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Abstract

This paper examines whether freshmen in introductory economics courses get better grades if they have other students in their on-campus residential unit who are either taking the same course or who have taken the course in the past. It uses nine years of data for the introductory economics course at Reed College. I find that having dorm-mates who are currently taking the class seems to have some benefit for students, but there is no evidence of benefit from having co-resident students who have previously completed the class.

1. Introduction

The study of student peer effects has become a prominent issue in the economics of education. Most studies of peer effects look at whether having peers with higher measured academic aptitude (such as higher SAT scores or other admission credentials) leads to improved performance. For reasons of econometric identification, the most common category of college peers to be examined is roommates, although most studies of primary and secondary students (and a few in higher education) have looked for classmate peer effects.

Many peer-effects studies have focused on primary- or secondary-school classmate effects, for example Henderson, Mieszkowski, and Sauvegeau (1976), Epple and Romano (1998), Hoxby (2000), Zimmer and Toma (2000), Boozer and Cacciola (2001), Gaviria and Raphael (2001), Vandenberghe (2002), Hanushek et al. (2003), McEwan (2003), Rangvid (2003), Robertson and Symons (2003), Zimmer (2003), Angrist and Lang (2004), Dills (2005), Lefgren (2004), Ammermueller and Pischke (2006), Burke and Sass (2006), Ding and Lehrer (2006), and Kang (2007). Although the evidence is not unanimous, many studies find support for the hypothesis that young students learn more if they have peers of higher ability.

Studies of peer effects in higher education have been more limited. When students select their peers on the basis of variables we cannot observe, it becomes impossible to identify the effects of the student's own characteristics from the effects of peers.[1] Most of the work on peer effects in higher education has focused on roommate and dorm-mate effects because these peers are assigned by colleges either randomly or based on observable criteria. Studies based on residential peers include Sacerdote (2001), Zimmerman (2003), Winston and Zimmerman (2004), Stinebrickner and Stinebrickner (2006), Foster (2006), Lyle (2007), Kremer and Levy (2008), and Stinebrickner and Stinebrickner (2008). These studies have found some evidence that more able roommates are beneficial; the most recent studies have suggested that the mechanism of roommate peer effects may operate through study time and alcohol use, which are more closely related to the attitudes and personalities of roommates than to their innate academic ability.

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[1] See Manski (1993).

Classmate peers are likely to influence a student's classroom environment; roommate peers may affect study habits and the student's overall college environment. But does it matter whether those living in a student's proximity are taking or have taken the student's current courses?

Many colleges and universities have pursued the idea of using residential assignments to group students together with others having similar academic or extracurricular interests in "living/learning communities."[2] The presence of these residential groups may affect students' contentment and attachment to the college as well as their academic performance.

Because the students in such communities typically take one or more courses together as a group, evaluation of such residential programs has consisted of comparing self-reported measures of satisfaction and intellectual development between treatment groups of students in such communities and control groups of students in traditional dormitories.

In one of the first studies of residential learning communities, Pike (1999) found that participating students had higher self-reported "learning and intellectual development" than the control group. More recently, Inkelas et al. (2006) report that self-reported growth in "critical thinking/analysis abilities" and several other intellectual outcomes was somewhat greater for students in living-learning communities than for students living in traditional residence halls at the same four large universities.

The living/learning community model usually involves all of the students in a particular course or section living together. While evidence of improved learning in such environments suggests positive peer effects from living near classmates, the special nature of such programs make it hard to generalize this evidence to the far more common situation of classmates who are randomly grouped together in a residential unit.

This paper examines whether freshmen's grades in introductory economics are affected by having classmates (or students who have taken the class) living in the same dormitory unit ("dorm-mates"). Using nine years of data for students in the introductory economics course at Reed College, I find that freshmen taking introductory economics gain from having dorm-

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[2] Inkelas et al. (2008) provides a typology of kinds of such programs and reviews the literature describing them.

mates who are currently taking the same course, but do not seem to benefit from having dorm-mates who have taken introductory economics in the past.

2. Classmates and Dorm-Mates

Most students who have lived in a college dormitory are likely to agree that dorm-mates can have a large influence on the college experience. One encounters the people living in one's dorm unit every day: in the halls, in the bathrooms, or just passing by an open door. Dorm-mates are natural candidates for friendship and companionship. Noisy dorm-mates can interrupt sleep and distract a student trying to study in his or her room. Partying dorm-mates, besides being noisy, may tempt a student to join in the activity and reduce his or her study time.

A dormitory may also be a convenient venue in which to identify and utilize study partners or tutors, but this is likely only if there are dorm-mates who are taking the same class (for study partners) or who have taken the course previously (for tutors). While students surely have other venues for finding such academic support, having more classmates living in the same dorm unit might afford a student a larger pool from which to draw potential study partners. If this larger pool increases the chance that the student finds someone with whom he or she can work productively then it may improve his or her performance in the class. Similarly, having more students nearby who have completed the class may enlarge the pool of individuals from whom a student may seek information, making it more likely that he or she is able to overcome difficulties in the class.

This study focuses on freshmen, although the class under examination enrolls higher-level students as well. (The term "higher-level students" is used here to mean all non-first-year students.) First-year students are the most appropriate population for two reasons. First, most higher-level students have already formed peer groups with students they met as classmates, dorm-mates, or in other ways during their previous year(s). Because they are more likely to have established peer groups, they are less dependent than first-year students on dorm-mates as sources of study partners or peer mentors.[3] Second, the Reed student database does not

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[3] Because Reed is a small, selective college drawing its student body from a national applicant pool, the vast majority of first-year students arrive on campus knowing no other Reed students. No entering

allow us to track living arrangements of the large share of (upper-level) students who live off campus. Hence, a group of higher-level students living on campus in the same dorm unit would be counted as dorm-mates, but a group of students who share an off-campus house—a very common living arrangement among higher-level Reedies—would be missed.

The mere number of classmates or students experienced in the subject in one's dorm is a crude measure of how much a student could benefit from studying with them or learning from them. We should consider not only the quantity but also the quality of the dorm-mate peers. Many factors undoubtedly affect the academic benefit drawn from a dorm-mate peer. Even at a selective college, students vary considerably in their academic ability and background. The nature of student interaction and learning may vary depending on the academic prowess of the student and the peer. A higher-level student who received an A in introductory economics would probably be a more effective mentor than one who got a C. Similarly, a fellow first-year student with strong academic credentials (SAT scores, high-school GPA, etc.) could (other things equal) be a better study partner than one whose credentials are weak. However, some excellent peers are likely to do assignments easily on their own, limiting their willingness to participate in group work. Moreover, peers who are academically less gifted may benefit a student by having a partner to struggle with on assignments or an opportunity to reinforce his or her own knowledge by helping the struggling peer.

Many characteristics beyond pure academic ability affect the contribution of a dorm-mate peer to a student's learning. Some students are very talented communicators; others less so. Some are inclined to study in groups and to spend academic time with peers; others are more academically reclusive. Some have interests and personalities that encourage their peers to try hard and succeed; others may distract peers from academic endeavors. These highly relevant characteristics of personality and attitude cannot be measured with available data. Thus, we must rely on measured academic quality as the sole indicator of peer quality.

The availability of dorm-mates as study partners and mentors can be measured crudely by the number of dorm-mates taking or having taken the same course, and these are the basic

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student at Reed would have a pre-established peer group of the kind that might occur when 25 graduates of the same high school attend a large state university and remain in contact with one another.

quantitative measures used in this study. I also employ two qualitative measures based on actual or predicted grades in the economics course. For students having taken the class previously, the grade they earned is used as a measure of academic ability in economics. For students currently taking introductory economics, I use the prediction of their grade from a regression of course grades on admission credentials such as SAT scores and admission-office ratings.

3. Institutional Setting

During the sample period, which runs from 1993–94 to 2001–02, the proportion of Reed College students living in on-campus residence halls increased from about 55% to about 65%. Throughout the period, nearly all first-year students (about 98%) lived on campus, with the exceptions being a handful of students who either lived at home or lived off campus due to special circumstances. Between one-third and one-half of higher-level students lived in college housing.

Reed residence halls vary considerably in size and style. Some are language houses with 8 to 30 students. Some are small dormitories with 25–30 students; others are large dorms with multiple floors and/or sections. The larger dormitory buildings are divided into smaller sections of 20–30 students that are overseen by a common "house advisor," who is a higher-level student who living in that dorm. Our definition of "dorm-mates" is a cohort of students living in the domain of a single house advisor (which may be an entire small dorm or a floor or section of a large one). Such sets of dorm-mates form natural groupings since they typically meet together periodically, share social rooms, kitchens, and bathroom facilities, and may participate jointly in college-funded social activities organized by their house advisors.[4]

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[4] In addition to dorms, Reed houses higher-level students in two apartment buildings adjacent to campus. Conversations with students who lived in both dorms and apartments suggest that residents in the apartment buildings do not interact in the same ways as those in dorms. The apartment buildings are larger (about 60 students) and lack the shared kitchen, bathroom, and social-room spaces of dorm units. We thus do not consider individuals who lived in the apartment buildings to be sharing a residential unit for purposes of this study. The results are not sensitive to this assumption as very few first-year students live in apartment housing.

Reed has no all-freshman dorms, meaning that all first-year students in the dorms live in proximity to at least a few higher-level students.[5] The proportion of first-years in residential units varied from about 40 percent for the most attractive dorms (which attract many upper-class students) to over 80 percent for those that are in less demand by returning students. Thus, the exposure of first-year students to higher-level students varied considerably. Some students had opportunities to find dorm-mates who had previously completed introductory economics, but many did not.

This paper focuses on students in Economics 201, a one-semester introductory course in economics. During the sample period, two sections of Econ 201 were taught each semester. Each semester, both sections were taught by the same instructor during back-to-back morning time slots. The course content consisted of basic microeconomic theory taught at the level of "intermediate micro" and somewhat less macroeconomic content taught at a level that varied from introductory to intermediate over time and across instructors. During the nine-year sample period 634 students received grades in Econ 201. Of these, 378 (60%) lived in dorms and 237 of those (37% of all students taking Econ 201) were first-year students. Of these 237 potential sample members, 12 were discarded because SAT scores were not available for them, leaving an estimating sample of 225 students.

4. Model, Variables, and Estimation

The dependent variable is success in learning introductory economics, measured by the grade received in Econ 201. The student's grade should depend on his or her own aptitude and, if dorm-mate peer effects are present, on the peer influences. Many other factors that are difficult to measure surely also affect the student's grade, such as effort level, the effectiveness of the instructor, and luck. These inevitably end up in the error term.[6]

The equation for the model can be written as

$$y_i = X_i\beta + P_i\gamma + \varepsilon_i, \tag{1}$$

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[5] The converse is not true. Reed has five language houses and, as noted above, two apartment buildings to which first-year students are rarely assigned.
[6] Dummy variables for instructor were examined and proved not to be significantly associated with grade.

where y_i is the student's grade in the introductory course (measured on a standard four-point scale), X_i is a row vector of control variables containing the student's own measured characteristics that are expected to affect his or her grade, P_i is a row vector describing the quantity and measured quality of student i's dorm-mate/classmate peers, and ε_i is an error term.

The elements of X_i should include all variables associated with the student's academic performance that we can measure prior to enrollment in the course. Because our sample consists of first-year students, no prior information on college-level performance is available. Thus X_i must be drawn from student i's admission credentials, such as SAT scores, high-school performance, and admission-office evaluations.

To capture the effects of dorm-mate peers, P_i should measure the availability within the residential unit of two kinds of student i's peers: potential study partners and potential mentors. Our basic, quantitative measures are the number of dorm-mates currently taking Econ 201 and the number of dorm-mates who have previously taken it.

We also want to look for possibly distinct effects of dorm-mates of either kind who are of high measured academic quality. For those who previously took Econ 201, we use the grade they earned in it. We have two quality-based measures for the availability of potential mentors; one is a dummy variable that is one if a student has a dorm-mate who completed the course with a grade of A– or better and the other sets the threshold at B+ or better.[7]

Measuring the academic quality of the dorm-mates who are currently taking an introductory course is more difficult. A dorm-mate's actual grade in the course is endogenous, potentially influenced by the original student's own performance through the very peer effects we seek to measure. There are several exogenous measures of various aspects of peer ability available, including the peers' math and verbal SAT scores, high-school grade-point average, high-school class-rank percentile, and the "reader rating" assigned by Reed's

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[7] The divisions are, of course, somewhat arbitrary. Approximately 22% of students during the sample period earned an A or A– in Econ 201, and another 15% earned a B+, so these categories correspond roughly to the top quarter and the top 3/8 of students in the course. Lowering the standard to B or better would include more than the top half of students (57%). Other measures of quality were explored in earlier versions of the study, including the average grade of dorm-mates and the best grade received in Econ 201 by a dorm-mate. These measures were never statistically significant and had the added disadvantage of being undefined for the (many) students with no dorm-mate who had completed Econ 201.

admission deans. Although one could enter each measure separately—peer math SAT, peer verbal SAT, peer high-school GPA, etc.—a single index of peer quality is less cumbersome. Because we are looking for a measure of peer aptitude in Econ 201, the weights attached to each individual ability measure should reflect the relevance of that measure to success in learning economics. For example, one might expect that the math SAT score would be more relevant to economics than the verbal score.

To find the appropriate weights to measure peers' academic aptitude for economics, we use ordinary least squares to estimate a linear relationship between the Econ 201 grade and student admission variables:

$$y_j = X_j \delta + \eta_j. \tag{2}$$

The estimates of δ provide weights to calculated a predicted course grade $\hat{y}_j$ for each peer in the sample.

Note that the same admission-file variables that affect a student's own performance should also affect those of his or her peers, so the variables included for the student in X_i in equation (1) are the same as those in X_j for the peers in equation (2). This means that the peer-ability measures in P_i are based on the same *variables* that are included in X_i, but they are for *different students*. For example, student i's own SAT scores are part of X_i; the SAT scores of his or her dorm-mate classmates go into the calculation of P_i. It also implies that if equation (1) is correctly specified, then equation (2) is the same equation with missing variables. Only if the elements of P_i are uncorrelated with X_i will the estimate of δ in equation (2) be unbiased.

Because P_i measures the characteristics of students living in the same residential unit as student i, P_i and X_i will be uncorrelated if students are assigned to residences in a manner that is independent of academic credentials. Staff members of the Reed Office of Residence Life are confident that this was the case through the sample period.

The predicted peer course grade based on (2) is used as a measure of course-specific peer aptitude. Although this measure of peer aptitude is exogenous—it is based solely on admission information that is determined prior to enrollment—it is a "generated regressor" that requires special econometric attention. Inference based on regressions with generated

regressors can be invalid; bootstrap methods described in the appendix are used to estimate corrected standard errors appropriate for the generated-regressor case.

As is often the case in college databases, some students are missing data for some variables. For example, some high schools do not report class rank; some have non-standard grade-point averages that cannot be converted to a four-point scale; a few students are admitted without SAT scores.[8]

Missing data are potentially problematic at two levels for this study: (1) some of student i's X variables may be missing or (2) data pertaining to i's peers may be missing, making it impossible to calculate P_i. Only about 60 percent of students have complete data on the full set of SAT scores, high-school GPA, high-school class rank, and admission rating in the Reed database. The data that are missing are plausibly "missing at random;" the probability that a value is missing is unrelated to the actual missing value. For example, high schools that fail to report class ranks on student transcripts do so for all students, not just for those with high or low ranks. When data are missing at random one can obtain valid estimates by using a sample consisting only of complete cases.

However, in peer-effect regressions, a complete-case analysis is highly restrictive. For illustration, suppose that each student has two randomly assigned peers and that we include only observations that have complete data for the student and for both peers. If 60 percent of students have complete data, then the probability of any three randomly drawn students *all* having complete data is $(0.6)^3 = 0.216$. The other 78.4 percent of the sample will have missing data either for the student or for one (or both) peers. Instead of losing less than half of the sample due to missing data we would lose nearly four-fifths.

To avoid this drastic sample reduction, only admission rating and SAT verbal and math scores are included in X_i in estimating equation (2), which is estimated only for the sample with complete data for these variables. Only 12 out of 237 first-year students are missing SAT scores (and all students have admission ratings), so the loss in sample size is small.[9]

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[8] In most cases the no-SAT students submitted ACT scores. Only the ACT composite score is retained in the college database, which does not allow us to decompose these scores into math and verbal components.

[9] An alternative method, which we have explored in detail, is to use multiple stochastic imputation to impute the values of the missing cases. Multiple imputation proved problematic in this application

The peer-effect regressions of equation (1) examine the effects of two quantitative and five quality-based peer variables. We measure the availability of potential study partners by the number of dorm-mates currently taking the course. We measure the availability of potential mentors by the number of dorm-mates who have previously taken the course.

To proxy for the availability of high-ability study partners, we measure the number dorm-mates currently taking the course whose predicted grade is in the top 50 percent of all predicted grades, and the number in the top 25 percent. As noted above, we have two quality-based measures for dorm-mates who have taken the course before based on their grades. We also measure the number of the dorm-mates who have previously taken Econ 201 and gone on to major in economics.

In addition to these seven peer measures, we include verbal and math SAT scores and the admission office reader rating as controls for student ability. Dummies for instructor were individually and collectively insignificant and were omitted.

Our sample is all first-year students completing Econ 201 between 1993–94 and 2001–02 who lived in dormitory housing. Summary statistics for the regression variables are shown in Table 1. Table 2 shows the distribution of values for the number of dorm-mates taking Economics 201 and the number having taken the course. Of the 225 freshmen in the sample, 164 had at least one potential mentor in their residential unit who had taken Econ 201 and the median number is one. The median number of classmates currently taking the class was also one and 126 of 225 had at least one classmate in their dorm unit as a potential study partner. Only 28 students in the sample had neither.

5. Results

The regressions for Economics 201 course grade are shown in Table 3. Each regression includes control variables, the total number of dorm-mates currently taking and having taken

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because of observations with pervasive missing data and because imputed values for variables such as SAT and high-school GPA were frequently out of range.

Econ 201, and one of the measures of dorm-mate academic quality. The regressions explain only about one-fifth of the variance in grades.[10]

The control variables have plausible signs, magnitude, and significance. Reader rating has a strong positive effect on the Econ 201 grade. SAT scores also affect the grade in the expected way: verbal SAT is estimated to have a small and statistically insignificant positive effect; math SAT has a stronger and statistically significant effect.[11]

The estimated effects of the number and quality of potential dorm-mate mentors having taken economics are consistently negative, small, and statistically insignificant. There is no evidence that first-year students gain from mentoring by their more experienced co-residents, even when those dorm-mates are economics majors or when they excelled in introductory economics themselves.

There is a small, positive, and statistically significant effect of having Econ 201 classmates living with them in the same residential unit. Depending on the specification, having one additional classmate in the same dorm raises the predicted grade by 0.13 to 0.18 grade points—about half of a plus-minus grade unit.

In contrast to prior expectations, having an additional student in the top half of the predicted grade distribution *lowers* the expected grade. Although this effect is not statistically significant, the point estimate is that having an additional high-ability classmate in the dorm offsets about half of the positive effect of the classmate's presence. Although the standard error of the coefficient is too large to make a statistical inference, this result suggests that it is the presence of weaker-than-average students in the dorm unit that may raise a student's grade the most.

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[10] This low R^2 is characteristics of all grade regressions using Reed College data, not just these for the economics course. In studies predicting cumulative GPAs of college students, admission variables typically explain around 40 percent of variation; at Reed such variables explain at best 25 percent.
[11] We must be careful to note that these coefficients are not true partial effects. A student with a higher SAT score (of either type) will, other things being equal, have a higher reader rating as well because higher scores will raise the admission deans' assessment of the student. Thus, a zero coefficient on an SAT score in these regressions would mean that the weight attached to the score in the reader rating exactly matches the weight of that score in predicting the Econ 201 grade. A positive coefficient means that the score is even more important for Econ 201 success than in forming the admission office's overall assessment. A negative coefficient on one of the SAT scores is plausible; it would mean that the admission deans put more weight on that SAT component than its importance in predicting the Econ 201 grade.

6. Interpretation

Taken as a whole, my results provide no support for the hypothesis that Reed College economics freshmen gain from having students in their residential unit who have expertise in economics. This outcome may reflect the accessibility of other kinds of academic support on the Reed campus. Student tutors are available for Econ 201 and faculty members are generally very accessible through office hours or appointments. Residential relationships may simply be unnecessary as sources of potential mentors.

The evidence is somewhat stronger that having economics classmates in a student's dorm affects the student's performance in Econ 201. This suggests that dorm networks may be a useful source of study partners.

A puzzling aspect of the results is that it appears that having classmates in the dorm unit with high measured academic potential does not help students get higher grades, and in fact may have a negative effect. Thus, there is no support for the idea that the gain in students' grades comes from being mentored by academically gifted classmates. However, there are at least two reasons why studying with lower-ability students might be beneficial. First, it may be that classmate-mentoring relationships enhance the learning of the mentor more than that of the student being helped. If this peer-mentoring hypothesis is the correct explanation for our results, then the effects we see in the aggregate data should be especially strong for a sub-sample of stronger students, since they are most likely to be drafted by dorm-mates as peer mentors.

The second hypothesis is that a student without a high-ability study partner may be forced to do more of the actual hard work on homework assignments because he or she cannot find anyone who has already successfully completed them. Struggling with difficult assignments without a high-ability study partner may lead to more effective learning, which could be reflected in higher exam scores and better overall grades, even if the grades on the assignment suffer from the lack of a better student's input. Such struggling may also entail additional visits to the instructor or course tutors, which might be more learning-enhancing than working with a very smart classmate on an assignment. If this working-independently hypothesis is true, then our aggregate results should apply strongly to a sub-sample of weaker students, who might free-ride on the efforts of stronger dorm-mates if they are available.

These alternative explanations are tested with separate regressions for sub-samples of Economics 201 students who were above and below the median predicted course grade. The mentors-gain hypothesis implies that peer effects should be strong for the above-median sample; the forced-to-do-the-work hypothesis means they should be strong for below-median students. The results support both hypotheses: the qualitative econometric results were very similar for the two sub-samples, although statistical significance was lower in both cases due to the reduced sample size. The hypothesis of equal coefficients on the peer variables cannot be rejected.

7. Conclusions

The econometric work reported here suggests that freshmen at Reed College draw some benefit from living in proximity to classmates. They do not seem to gain from having dorm-mates who have taken their classes in previous years.

A complementary approach to studying this question would be to survey students about their study habits. A survey could ask students directly how much they study with classmates and where they met their study partners. It could ask whether they sought help from more advanced students and whether dorm contact played a role in finding these mentors. However, a survey alone could not answer the more central question of this paper, which is whether studying with dorm-mates or mentoring by dorm-mates leads to improved academic performance. Only by linking the results of the survey with actual grade outcomes could one effectively assess whether students who study with dorm-mates earn higher grades.

One must be careful in extending the results reported here to other settings. Reed College has a number of distinctive characteristics that may impede generalization of these results to other institutions. Perhaps most important, it is a small, largely residential academic community in which it is relatively easy for students for form networks of friends, mentors, and study partners. Students may be less reliant on dorm-mates in such an environment than they would be in a larger university where students are more dispersed.

Reed is selective in admissions, so the range of academic abilities among the students may be smaller than the range at less selective institutions. This could affect the kind of study-

partner relationships that are most productive, making joint work by peers of similar ability more common and peer-mentoring of very weak students less common.

Reed is unusual even among selective liberal-arts colleges in its devotion to academics and its approach to grading. There are no athletic teams or Greek social organizations and interest in extra-curricular activities is very limited. The Reed Library is the social center of campus. Grades are de-emphasized in favor of learning for its own sake; faculty usually do not put numerical or letter grades on exams or papers and students are not automatically informed of their grades (as long as they are satisfactory) during or after the course, though they can get grades at mid-term and the end of the semester by inquiring through their academic advisor.

In this environment, academics are at the center stage and we would expect peer and mentoring relationships to be very important. The emphasis on learning vs. grades should encourage students to focus their work on problem sets and lab assignments more on learning and less on simply getting the assignment done correctly and handed in, though there remains plenty of pressure for the latter.[12]

In short, Reed College and selective liberal-arts colleges in general are a small but important part of American higher education. The kinds of classmate/dorm-mate interactions we study could be either more important or less important than at larger and less selective institutions. The academic enterprise is taken very seriously at these schools, which may encourage a greater degree of collaboration. However, the institutions are small, which should give students more opportunities to collaborate with classmates outside the residential setting. High accessibility of faculty may reduce the extent to which students utilize peer-mentoring and, as noted above, the limited range of academic abilities may limit the need for it.

This paper suggests that the opportunity to interact with classmates in a residential environment may improve academic performance of freshmen in some introductory courses. Whether this result extends to other liberal-arts colleges and to universities awaits further analysis.

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[12] Another study finds strong evidence that collaboration by Reed economics students takes the form of mutual contributions to homework assignments rather than free-riding by one student on the work of another. See Parker (2010).

Tables

Table 1. Summary statistics

	Econ 201 sample	
	Mean	S.D.
Course grade	2.83	0.91
Math SAT (/100)	6.65	0.66
Verbal SAT (/100)	6.83	0.71
Reader rating	3.39	0.61
Dorm-mates taking: Total	0.88	1.00
Dorm-mates taking: $>50^{th}$ percentile	0.49	0.73
Dorm-mates taking: $>75^{th}$ percentile	0.25	0.55
Dorm-mates having taken: Total	1.34	1.40
Dorm-mates having taken: Majors	0.28	0.52
Dorm-mate having taken: B+ or better?	0.38	0.49
Dorm-mate having taken: A– or better?	0.28	0.45

Table 2. Dorm-mates taking and having taken Economics 201

		Number of dorm-mates having taken Economics 201						
		0	1	2	3	4	5+	Total
Number of dorm-mates taking Economics 201	0	28	42	14	11	3	3	101
	1	21	30	11	9	1	2	74
	2	8	9	9	0	1	3	30
	3	4	9	2	0	0	2	17
	4	0	3	0	0	0	0	3
	Total	61	93	36	20	5	10	225

Table 3. Economics 201 regression results

		(1)	(2)	(3)	(4)	(5)
Own control variables	Reader rating (1 – 5 scale)	0.441***	0.440***	0.436***	0.428***	0.436***
		(0.0821)	(0.0832)	(0.0819)	(0.0827)	(0.0821)
	Verbal SAT (in 100s)	0.0976	0.101	0.0988	0.0989	0.0989
		(0.110)	(0.110)	(0.109)	(0.109)	(0.109)
	Math SAT (in 100s)	0.211**	0.212**	0.216**	0.215**	0.216**
		(0.0846)	(0.0839)	(0.0846)	(0.0843)	(0.0839)
Dorm-mates currently taking Econ 201	Total	0.177**	0.151**	0.129**	0.127**	0.129**
		(0.0850)	(0.0626)	(0.0512)	(0.0508)	(0.0505)
	Predicted grade above 50th pctl.	−0.0805				
		(0.111)				
	Predicted grade above 75th pctl.		−0.0714			
			(0.112)			
Dorm-mates having previously taken Econ 201	Total	−0.0537	−0.0515	−0.0559	−0.0375	−0.0399
		(0.0390)	(0.0386)	(0.0417)	(0.0424)	(0.0416)
	Economics majors			0.00496		
				(0.100)		
	Earned B+ or better?				−0.0921	
					(0.124)	
	Earned A− or better?					−0.0884
						(0.131)
	Constant	−0.782	−0.806	−0.797	−0.756	−0.792
		(0.793)	(0.784)	(0.792)	(0.774)	(0.785)
	Observations	225	225	225	225	225
	R–squared	0.199	0.199	0.198	0.199	0.199

Dependent variable is grade earned in Economics 201 (0.0 – 4.0).

Robust standard errors in parentheses. Bootstrap standard errors used for generated variables.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Appendix: Bootstrap standard errors

Each replication k of the bootstrap algorithm can be summarized by the following sequence of steps:

1) Generate a simulated grade-prediction error term $\tilde{u}_j^k$ for each student j. This can be done in either of two ways:

   a) parametrically using a normal distribution with mean zero and variance equal to the estimated error variance from the OLS grade-prediction regression, or

   b) non-parametrically by re-sampling from the residuals of the grade-prediction OLS regression.

2) Create a simulated course grade $\tilde{y}_j^k = X_j \hat{\delta} + \tilde{u}_j^k$, where $\hat{\delta}$ is the OLS estimate of the coefficient vector in the grade-prediction regression. Actual course grades can take on only the feasible values 4.0, 3.7, 3.3, 3.0, 2.7, 2.3, 2.0, 1.7, 1.0, and 0.0, corresponding to the course grades of A, A−, B+, B, B−, C+, C, C−, D, and F. Thus, one could choose either to:

   a) round the simulated course grade to the nearest feasible value, or

   b) leave the simulated course grade as a continuous variable.

3) Regress the simulated course grade $\tilde{y}_j^k$ on X_j to get first-stage estimates and this replication's first-stage coefficient estimate $\tilde{\delta}^k$.

4) Compute the simulated instrumented course grade for each student as $\hat{\tilde{y}}_j^k = X_j \tilde{\delta}^k$.

5) Calculate the simulated peer variables for the replication $\tilde{P}_i^k$ based on simulated instrumented course grades.

6) Generate a simulated error term $\tilde{\varepsilon}_i^k$ for each student in the second-stage estimating sample. This can be done either

   a) parametrically using a normal distribution with mean zero and variance equal to the estimated error variance from the second-stage regression, calculated with P variables based on actual grades rather than predicted grades, or

   b) non-parametrically by re-sampling from the residuals of this second-stage regression calculated with the P values based on actual grades.[13]

7) Create a second-stage simulated course grade for each student $\tilde{y}_i^k = X_i \hat{\beta} + \tilde{P}_i^k \hat{\gamma} + \tilde{\varepsilon}_i^k$, where $\hat{\beta}$ and $\hat{\gamma}$ are the estimated values from the second-stage. The generated dependent variable is either rounded to the nearest grade value or left unrounded, depending on the setting of that option.

8) Regress $\tilde{y}_i^k$ on X_i and $\tilde{P}_i^k$, saving the estimated coefficients $\tilde{\gamma}^k$.

The above steps are repeated 10,000 times (indexed by k). The bootstrap standard errors are the standard deviations of the estimated coefficients over the replications. Where p values are

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[13] This procedure corresponds to the use of actual rather than fitted regressors in calculating the standard error in the second stage of two-stage least squares. Note that calculation of residuals with actual values of the instrumented regressors is tricky in this case. The instrumented variables are the number of students falling above a particular percentile threshold. The instrumented values are continuous, so percentiles are uniquely defined. However, the actual values of course grade take on a limited number of values, so many observations share the values at the 50th and 75th percentiles. To get around this problem, dorm-mates with the median course grade are counted as a fraction corresponding to the share of the students having that grade who fall above the median. For example, grade B+ comprises students from the 63.67th to the 78.40th percentiles, so each of the students with a B+ counts as (78.40-75)/(78.40-63.67) = 0.2308 fraction of an above-75th-percentile peer for his or her dorm-mates. The grade B straddles the 50th percentile with each B student counting as 0.6801 fraction of an above-50th-percentile peer. The standard errors based on residual computed with dorm-mate actual grade variables calculated by this method.

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required, they can be computed using the quantiles of the simulated distribution of the estimated coefficients.

As noted above, there are two sets of alternative assumptions that may be adopted in calculating the bootstrap standard errors. One can either round the simulated course grades to feasible values or not, and one can use parametric or non-parametric error terms. In practice, the results of all of the bootstrap calculations of standard errors were close to one another and also close to the second-stage robust OLS standard errors. Table A-1 compares the standard error estimates for the coefficients of the Econ 201 equation using several alternatives. Table 3 reports non-parametric bootstrap standard errors imposing discontinuity of course grades by rounding; the statistical significance of the coefficients would not be strongly affected by choosing another option.

Table A-1. Alternative standard error estimates

		SE of coefficient on number of dorm-mates with grade in:	
		50th percentile	75th percentile
OLS robust standard error		0.112	0.113
Bootstrap standard error variant:			
Parametric	Rounded	0.107	0.108
Parametric	Not rounded	0.118	0.118
Non-parametric	Rounded	0.111	0.112
Non-parametric	Not rounded	0.115	0.115

References

Ammermueller, Andreas, and Jörn-Steffen Pischke. 2006. Peer Effects in European Primary Schools: Evidence from PIRLS. In *Working Paper*. Cambridge, Mass.: National Bureau of Economic Research.

Angrist, Joshua D., and Kevin Lang. 2004. How Important are Classroom Peer Effects? Evidence from Boston's Metco Program. In *Working Paper*. Cambridge, Mass.: National Bureau of Economic Research.

Boozer, Michael A., and Stephen E. Cacciola. 2001. Inside the 'Black Box' of Project Star: Estimation of Peer Effects Using Experimental Data. In *Discussion Paper*. New Haven, Conn.: Yale University Economic Growth Center.

Burke, Mary A., and Tim R. Sass. 2006. Classroom Peer Effects and Student Achievement. In *Working Paper.* Tallahassee, Fla.: Florida State University Department of Economics.

Dills, Angela K. 2005. Does Cream-Skimming Curdle the Milk? A Study of Peer Effects. *Economics of Education Review* 24 (1):19-28.

Ding, Weili, and Steven F. Lehrer. 2006. Do Peers Affect Student Achievement in China's Secondary Schools? In *Working Paper*. Cambridge, Mass.: National Bureau of Economic Research.

Epple, Dennis, and Richard E. Romano. 1998. Competition between Private and Public Schools, Vouchers, and Peer-Group Effects. *American Economic Review* 88 (1):33-62.

Foster, Gigi. 2006. It's Not Your Peers, and It's Not Your Friends: Some Progress toward Understanding the Educational Peer Effect Mechanism. *Journal of Public Economics* 90 (8-9):1455-75.

Gaviria, Alejandro, and Steven Raphael. 2001. School-Based Peer Effects and Juvenile Behavior. *Review of Economics and Statistics* 83 (2):257-68.

Hanushek, Eric A., John F. Kain, Jacob M. Markman, and Steven G. Rivkin. 2003. Does Peer Ability Affect Student Achievement? *Journal of Applied Econometrics* 18 (5):527-544.

Henderson, Vernon, Peter Mieszkowski, and Yvon Sauvegeau. 1976. Peer Group Effects and Educational Production Functions. Ottawa: Economic Council of Canada.

Hoxby, Caroline. 2000. Peer Effects in the Classroom: Learning from Gender and Race Variation. In *Working Paper*. Cambridge, Mass.: National Bureau of Economic Research.

Inkelas, Karen Kurotsuchi, Matthew Soldner, Susan D. Longerbeam, and Jeannie Brown Leonard. 2008. Differences in Student Outcomes by Types of Living–Learning Programs: The Development of an Empirical Typology. *Research in Higher Education* 49:495-512.

Inkelas, Karen Kurotsuchi, Kristen E. Vogt, Susan D. Longerbeam, Julie Owen, and Dawn Johnson. 2006. Measuring Outcomes of Living-Learning Programs: Examining College Environments and Student Learning and Development. *Journal of General Education* 55 (1):40-76.

Kang, Changhui. 2007. Classroom Peer Effects and Academic Achievement: Quasi-Randomization Evidence from South Korea. *Journal of Urban Economics* 61 (3):458-495.

Kremer, Michael, and Dan Levy. 2008. Peer Effects and Alcohol Use among College Students. *Journal of Economic Perspectives* 22 (3):189-206.

Lefgren, Lars. 2004. Educational Peer Effects and the Chicago Public Schools. *Journal of Urban Economics* 56 (2):169-191.

Lyle, David S. 2007. Estimating and Interpreting Peer and Role Model Effects from Randomly Assigned Social Groups at West Point. *Review of Economics and Statistics* 89 (2):289-299.

Manski, Charles F. 1993. Identification of Endogenous Social Effects: The Reflection Problem. *Review of Economic Studies* 60 (3):531-542.

McEwan, Patrick J. 2003. Peer Effects on Student Achievement: Evidence from Chile. *Economics of Education Review* 22 (2):131-41.

Parker, Jeffrey. 2010. An Empirical Examination of the Roles of Ability and Gender in Collaborative Homework Assignments. *Journal of Economic Education* 41 (1):15-30.

Pike, Gary R. 1999. The Effects of Residential Learning Communities and Traditional Residential Living Arrangements on Educational Gains During the First Year of College. *Journal of College Student Development* 40 (3):269-284.

Rangvid, Beatrice Schindler. 2003. Educational Peer Effects: Regression Evidence from Denmark with PISA2000 Data. Copenhagen: AKF, Institute for Local Government Studies.

Robertson, Donald, and James Symons. 2003. Do Peer Groups Matter? Peer Group versus Schooling Effects on Academic Attainment. *Economica* 70 (277):31-53.

Sacerdote, Bruce. 2001. Peer Effects with Random Assignment: Results for Dartmouth Roommates. *Quarterly Journal of Economics* 116 (2):681-704.

Stinebrickner, Ralph, and Todd R. Stinebrickner. 2006. What Can Be Learned about Peer Effects Using College Roommates? Evidence from New Survey Data and Students from Disadvantaged Backgrounds. *Journal of Public Economics* 90 (8-9):1435-54.

———. 2008. The Causal Effect of Studying on Academic Performance. *B.E. Journal of Economic Analysis & Policy* 8 (1: Frontiers):Article 14.

Vandenberghe, V. 2002. Evaluating the Magnitude and the Stakes of Peer Effects Analysing Science and Math Achievement across OECD. *Applied Economics* 34 (10):1283-90.

Winston, Gordon C., and David J. Zimmerman. 2004. Peer Effects in Higher Education. In *College Choices: The Economics of Where to Go, When to Go, and How to Pay for It*, edited by C. Hoxby. Chicago: National Bureau of Economic Research and University of Chicago Press.

Zimmer, Ron. 2003. A New Twist in the Educational Tracking Debate. *Economics of Education Review* 22 (3):307-315.

Zimmer, Ron W., and Eugenia F. Toma. 2000. Peer Effects in Private and Public Schools across Countries. *Journal of Policy Analysis and Management* 19 (1):75-92.

Zimmerman, David J. 2003. Peer Effects in Academic Outcomes: Evidence from a Natural Experiment. *Review of Economics and Statistics* 85 (1):9-23.