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The Journal of Economic Education

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/vece20>

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Version of record first published: 18 Jan 2013.

To cite this article: Wendy A. Stock , Kevin Ward , Justin Folsom , Teresa Borrenpohl , Sophie Mumford , Zach Pershin , Danielle Carriere & Heather Smart (2013): Cheap and Effective: The Impact of Student-Led Recitation Classes on Learning Outcomes in Introductory Economics, The Journal of Economic Education, 44:1, 1-16

To link to this article: <http://dx.doi.org/10.1080/00220485.2013.740368>

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RESEARCH IN ECONOMIC EDUCATION

Cheap and Effective: The Impact of Student-Led Recitation Classes on Learning Outcomes in Introductory Economics

Wendy A. Stock, Kevin Ward, Justin Folsom, Teresa Borrenpohl, Sophie Mumford,
Zach Pershin, Danielle Carriere, and Heather Smart

The authors examine the impacts of enrollment in a voluntary one-credit recitation class for ECON 101 students, focusing on course grades, course retention, and outcomes in later economics courses. The recitation classes were taught by undergraduate peer leaders with experience in upper-level microeconomics. Instead of being paid, the peer leaders enrolled in a three-credit course focused on examining research on economics pedagogy. After controlling for students' academic, demographic, and work-related characteristics, the authors' estimates indicate that recitation class students earned higher final grades than their ECON 101 counterparts. Additionally, although they were weaker students based on their ACT scores, those who enrolled in the recitation class were no more likely to drop ECON 101 than their counterparts who did not enroll in the recitation class.

Keywords *assessment, economics education, introductory economics, peer leadership, recitation*

JEL codes A10, A22

In 2009, a voluntary one-credit recitation course was offered to introductory economics students at a state university (SU) in the United States. The goal of the recitation course was to improve student retention, learning, and performance in ECON 101 (The Economic Way of Thinking), the introductory course in economics at SU. As an alternative to paying for instructors to lead the recitation course, undergraduate student peer-leaders were recruited to teach individual sections of the recitation in exchange for course credit. Using data on student demographic and background characteristics, course characteristics, and instructor fixed effects, we estimated whether students

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The authors are thankful for helpful comments from Mark Anderson, Andrea Beller, Tim Fitzgerald, Gregory Gilpin, and seminar participants at Montana State University, the 2010 National Conference on Undergraduate Research, the 2010 Society of Economic Educators Conference, and the 2011 National Conference on Teaching Economics.

who enrolled in the recitation course had lower attrition, better class performance in ECON 101, increased probability of enrollment in subsequent economics courses, and better performance in later economics courses. We found that students who selected to enroll in the recitation course had lower college entrance exam scores on average than their ECON 101 peers who chose not to enroll. Despite being relatively weaker students, students who enrolled in the recitation course were no more likely to drop out of ECON 101 than their peers. Among those who completed ECON 101, students who enrolled in the recitation course earned higher grades than their counterparts who did not enroll in the recitation course. After tracking the progress of ECON 101 cohorts through several semesters, we also found that relative to their ECON 101 counterparts who did not enroll, students who enrolled in the recitation course did not have different attrition rates or final grades in subsequent economics courses.

DESCRIPTION OF COURSES

The introductory course in economics at SU is ECON 101, *The Economic Way of Thinking*. This three-credit semester-long course is one of several elective choices that fulfill the social science general education requirement at SU, so students in ECON 101 come from a wide range of majors.¹ For most students, ECON 101 is the only economics course they will take at SU. The course has no math prerequisite and is taught in a large-lecture format. There are typically two or three sections of ECON 101 offered each semester, with enrollment ranging between 200 and 300 students in each section. Although the sections are taught by different instructors, the topic coverage is similar and the timing of the topics covered is coordinated across sections. Students in the course take multiple choice exams and complete online homework assignments. The course is taught using the “issues in economics” pedagogy rather than a traditional principles format. In an issues-based course, students learn a set of core tools used in economics (e.g., marginal benefit/marginal cost, demand and supply, comparative advantage) and then apply these tools to an array of social issues including the economics of the environment, farm policy, international trade, healthcare, drugs and crime, education, labor markets, poverty, and the income distribution.²

ECON 101 is one of the more difficult introductory-level courses at SU, as a consistently high proportion of students (25 percent or more) in ECON 101 earn D, F, or W (withdrawal) grades in the course. In an effort to improve student outcomes in ECON 101, a new course, ECON 105—*Study in the Economic Way of Thinking*, was introduced in 2009. ECON 105 is a voluntary one-credit semester-long recitation course designed to complement ECON 101 by providing group problem-solving and discussion of topics concurrently covered in ECON 101, but in a smaller class format and with increased individual attention from the instructor. To encourage student participation and interaction, all ECON 105 sections are limited to enrollment of 25 or fewer students. During the first week of each semester, all ECON 101 students are told about the availability of ECON 105 and are encouraged to enroll. About 17 percent of ECON 101 students choose to concurrently enroll in ECON 105. Grades in ECON 101 and ECON 105 are determined independently from one another. ECON 105 grades are based on attendance, class participation, performance on short assessment quizzes, and performance on in-class problem sets. ECON 101 grades are based on performance on exams and online homework assignments.

ECON 105 sections are led by undergraduate students, called “peer leaders,” who are selected based on their performance in upper-division economics courses at SU. Rather than working for

pay, peer leaders enroll in ECON 305—Peer Leadership in Economics, a three-credit semester-long course that focuses on readings and research on economics pedagogy. The goals of the ECON 305 course are to deepen peer leaders' understanding of basic economic theory, to develop leadership and organization skills, and to develop peer leaders' independent research capabilities. In addition to leading their own ECON 105 recitation section each week, each student in ECON 305 writes questions for the common problem sets and quizzes assigned in ECON 105 each week, contributes to group discussion of assigned readings, and writes an independent research paper on a topic in economic education. All ECON 305 sections are taught by the same professor, whose job also includes coordinating topic coverage between the ECON 105 and ECON 101 courses. By offering the peer leaders course credit, the ECON 105 course was implemented at a lower cost than would have been the case if the peer leaders were paid stipends or if tenure-track or adjunct faculty were hired to teach the course.

The ECON 305 course counts as an elective in the economics curriculum at SU. Other 300-level electives at SU include labor economics, international economics, public finance, environmental economics, development economics, and money and banking. Although we have not done a formal analysis to compare the economics learning gains in ECON 305 relative to those in these other electives, Siegfried (1977) found that student instructors of an introductory economics course at Vanderbilt University had more improvement on a standardized test of economics principles than was gained from taking an additional elective course in economics. ECON 305 students also use the course as a resume-builder and for increased practice in public speaking.³

PREVIOUS RESEARCH

Previous research on the impact of additional exposure to economics on student performance has focused primarily on the impact of supplemental instruction (SI) programs. SI entails peer-assisted study sessions for students in introductory-level courses. SI sessions are regularly scheduled, informal review sessions that students attend on a voluntary, drop-in basis.

Evidence on the impact of SI on student outcomes in economics is somewhat mixed. Worthington and colleagues (1997) found no impact of SI on student class performance in introductory economics, while Etter, Burmeister, and Elder (2001) and Blanc, DeBuhr, and Martin (1983) found that SI contributed to improved grades and retention. None of these studies controlled for student self-selection into SI, however. Because student participation in SI is voluntary and nonrandom, it is important to control for self-selection bias when estimating the impact of SI on student performance. Lewis and colleagues (2005) and Loviscek and Cloutier (1997) controlled for self-selection into SI by randomization and instrumental variables estimation, respectively. They found that student grades and retention in economics were improved by SI.

Huynh, Jacho-Chavez, and Self (2010) also examined the impact of additional exposure to economics on student learning in introductory microeconomics. In their study, students could voluntarily elect to participate in collaborative learning (CL) recitation sessions in addition to course lectures. Although the CL sessions were structured to incentivize participation by rewarding CL students with points in the microeconomics lecture class, students were not enrolled in the CL sessions for course credit. Using propensity score matching to address the self-selection problem, Huynh and colleagues found that participation in the CL sessions was associated with increased student performance in introductory microeconomics.

We also used propensity score matching (PSM) to control for self-selection of students into the ECON 105 class.⁴ Under this method, a control group for estimating the impact of ECON 105 was developed by matching students in ECON 105 (the treated group) with comparable students not enrolled in ECON 105, but with otherwise similar characteristics (the untreated group). Outcomes for the treated and untreated groups were then compared to obtain estimates of the average treatment effect on the treated group.⁵ The matching was done by first fitting a binary regression (e.g., probit) for whether or not a student was enrolled in ECON 105 on a set of observable characteristics (X). This regression yielded an estimate of the probability of treatment (i.e., enrollment in ECON 105) for each student, called the propensity score. The sample was then split into intervals of the propensity score so that within each interval the average probability of treatment and the average of each X variable for the treated and untreated groups were the same. The average treatment effect was then estimated by comparing differences in outcomes for the matched observations.⁶

DATA

The data for this study came from four sources.⁷ First, an identification number, class standing, major, ACT, and SAT scores were obtained for all ECON 101 students during the fall 2009, spring 2010, and fall 2010 semesters using official enrollment records from the SU Office of the Registrar. We grouped students' majors into *social science*, *natural science*, *arts & humanities*, *business*, *university studies*, *engineering*, and *other* categories.⁸ Because some students took the ACT while others took the SAT, we used the conversion matrix from the ACT web site to translate SAT total scores into their ACT composite equivalencies.⁹

Some students enrolled in ECON 101 more than once during the three semesters of our study (e.g., because they failed the course the first time or because they retaken the course to improve their GPA). Because it is difficult to disentangle the impact of repeating the class on ECON 101 class performance from the impact of ECON 105 on ECON 101 class performance, we include "repeat" students in the sample only during the first semester that they enrolled in ECON 101 during the span of our study.¹⁰ Of the initial 1,728 students enrolled in ECON 101 during the study period, 100 students repeated the course at least once during the period (including five students who repeated the course twice during the study period). The repeat observations on these students were eliminated from the sample. Because they do not have a college major, we also eliminated from the sample 18 non-degree-seeking students, post-baccalaureate students, and graduate students who enrolled in ECON 101 during the period, leaving our sample at 1,610 students. Official university enrollment records were used to generate an indicator for whether each ECON 101 student also enrolled in ECON 105 the same semester. Seventeen percent of the ECON 101 students enrolled in ECON 105 during the study period.

Second, student outcomes in ECON 101 were obtained from each of the two instructors who taught the course during our study period. For each section of ECON 101, student performance was measured using final course grades (measured in percentages). To account for potential systematic differences in course difficulty or student performance across instructors and across semesters, grades were normalized as a percentage of the highest score earned in each ECON 101 section each semester.

Attrition from ECON 101 was measured by comparing official enrollment rosters against final course grade rosters. Students who enrolled in ECON 101 and then subsequently withdrew and

students who did not withdraw but who earned fewer than 25 percent of the points possible in ECON 101 were both defined as dropouts from ECON 101. The latter group makes up 4 percent of the dropouts and primarily consists of students who enrolled in ECON 101, did not officially drop the course, but did not attend or complete course assignments and tests throughout the semester.¹¹

Third, all students enrolled in ECON 101 during the study period semesters were asked a set of survey questions about their demographic and educational background characteristics, their work status, and the number of credits they were enrolled in when they took ECON 101. The survey was administered as part of the first online homework assignment in ECON 101, which was due at the end of the second week of class each semester. A total of 1,087 of the 1,610 ECON 101 students (68 percent) provided complete demographic and background information in the survey. We discuss issues related to the response rate for this survey below.

Finally, using the student identification numbers, we followed the progress of the students who completed ECON 101 during our study period as they subsequently made choices to enroll in either Principles of Macroeconomics or Principles of Microeconomics during the spring 2010, summer 2010, fall 2010, or spring 2011 semesters. These principles courses constitute the next level of economics instruction offered at SU, and both require ECON 101 as a prerequisite. As with the ECON 101 performance measures, we obtained attrition and final grade information from SU enrollment records and from the principles course instructors. We defined attrition from the principles courses using the same criteria we used to define attrition from ECON 101, and we normalized student grades as a percentage of the highest score earned in each principles section in each semester.

Table 1 presents student outcomes in ECON 101 for all students, for those who enrolled in ECON 105, and for those who did not enroll in ECON 105. The overall dropout rate was 14 percent for the 1,610 students enrolled in ECON 101 during our study period. Among those who also enrolled in ECON 105, the dropout rate was 11 percent, while among those who did not enroll in ECON 105, the dropout rate was 15 percent. Although the dropout rate was lower among those who enrolled in ECON 105 than their peers, the difference is significant at only the 0.11 level.

The average final grade for the 1,382 students who completed ECON 101 was 76 percent. Among those who enrolled in ECON 105, the average ECON 101 grade was 77 percent, statistically significantly higher than the 75-percent average grade of those who did not enroll in ECON 105. Based on these raw means, it appears that students who enrolled in ECON 105 were no more

TABLE 1
Student Outcomes in ECON 101

	All ECON 101 students			ECON 101 students who enrolled in ECON 105			ECON 101 students who did not enroll in ECON 105		
	Mean	St. dev.	N	Mean	St. dev.	N	Mean	St. dev.	N
Dropped ECON 101	0.14	0.35	1,610	0.11	0.32	278	0.15	0.36	1,332
Grade in ECON 101 (%)	75.55	13.44	1,382	77.28 ^a	13.58	247	75.19 ^{<}	13.39	1,135

^aThe > and < superscripts indicate that the mean is statistically different for students who enrolled in ECON 105 than for students who did not enroll in ECON 105 (p -value = 0.05 or smaller, two-tailed tests).

likely to drop out of ECON 101 than their peers, and among those who completed ECON 101, those in ECON 105 earned higher final grades than their peers.

As mentioned above, we have complete demographic and background information for the 68 percent of the ECON 101 students who completed a survey at the beginning of the semester. Table 2 summarizes the attrition, grade, and ECON 105 enrollment characteristics of the students who did and did not provide complete demographic and background data in the survey. The mean dropout rates and final grades earned in ECON 101 are different for the two groups. Among the 1,087 students for whom we have complete information, the dropout rate is 8 percent. The dropout rate among the 523 students who did not provide complete demographic information is 27 percent, and the difference in these dropout rates is statistically significant at the 0.05 level. The two groups are also different in the final grades they earned in ECON 101. Those who provided complete information in the survey earned an average final grade of 77 percent, while those who did not provide complete information earned a 73-percent average grade.

If uncorrected, the difference in survey response among the groups would bias our estimates of the impact of enrollment in ECON 105 if the groups also enrolled in ECON 105 at statistically different rates. Eighteen percent of those for whom we have complete information enrolled in ECON 105, while only 15 percent of those who did not provide complete information enrolled in ECON 105. However, the difference between these two enrollment rates is not statistically significant, indicating that our estimates are unlikely to be biased because of nonrandom response to the demographic survey.

We have complete grade, class standing, major, demographic, background, and work characteristics for 1,087 of the 1,610 ECON 101 students in our sample. Table 3 reports the mean characteristics of the group as a whole and for the subsamples who did and did not enroll in ECON 105.

The vast majority (71 percent) of the students who took ECON 101 were freshmen. One in five of the students were sophomores, and about 10 percent were juniors or seniors. Business majors comprised the largest proportion of the students, followed by engineering majors. The average student in ECON 101 was 19 years old and taking 15 semester credits when enrolled in ECON 101. One-third of the students were female, and 70 percent of the students were single (defined as unmarried and not in a serious relationship). Nine percent of the students had previously taken economics in college. Because ECON 101 is the first economics course offered at SU, this group

TABLE 2
Student Outcomes by Groups with and without Complete Demographic Data

	All ECON 101 students			ECON 101 students with complete demographic and background data			ECON 101 students with incomplete demographic and background data		
	Mean	St. dev.	N	Mean	St. dev.	N	Mean	St. dev.	N
Dropped ECON 101	0.14	0.35	1,610	0.08 ^{<a}	0.27	1,087	0.27 ^{>}	0.44	523
Grade in ECON 101 (%)	75.55	13.44	1,382	76.60 ^{>}	12.68	998	72.84 ^{<}	14.87	384
Enrolled in ECON 105	0.17	0.38	1,610	0.18	0.39	1,087	0.15	0.35	523

^aThe > and < superscripts indicate that the mean is statistically different for students with complete demographic and background data than for students without such data (p -value = 0.05 or smaller, two-tailed tests).

TABLE 3
Student Characteristics

	All ECON 101 students		ECON 101 students who enrolled in ECON 105		ECON 101 students who did not enroll ECON 105	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
ECON 101 outcomes						
Dropped ECON 101	0.08	0.27	0.09	0.29	0.08	0.27
Grade in ECON 101 (%) ^a	76.60	12.70	77.26	12.79	76.46	12.68
Class standing						
Freshman	0.71	0.45	0.75	0.43	0.70	0.46
Sophomore	0.20	0.40	0.18	0.38	0.20	0.40
Junior	0.06	0.23	0.05	0.22	0.06	0.23
Senior	0.04	0.20	0.02	0.14	0.04	0.21
Major						
Social science	0.07	0.26	0.08	0.28	0.07	0.26
Natural science	0.16	0.37	0.13	0.34	0.17	0.37
Arts & humanities	0.05	0.21	0.04	0.21	0.05	0.21
Business	0.33	0.47	0.45 ^{>b}	0.50	0.30 ^{<}	0.46
University studies	0.16	0.37	0.17	0.38	0.16	0.36
Engineering	0.21	0.41	0.11 ^{<}	0.31	0.23 ^{>}	0.42
Other	0.03	0.16	0.01	0.10	0.03	0.17
Background characteristics						
Age (years)	19.26	1.84	19.25	1.71	19.26	1.87
Female	0.32	0.47	0.45 ^{>}	0.50	0.29 ^{<}	0.45
Single	0.70	0.46	0.67	0.47	0.70	0.46
Taken prior econ in college	0.09	0.29	0.10	0.30	0.09	0.28
Taken prior econ in h.s.	0.30	0.46	0.29	0.45	0.31	0.46
In-state resident	0.59	0.49	0.64	0.48	0.58	0.49
First-gen. college student	0.13	0.34	0.10	0.31	0.14	0.35
Have ever used a tutor	0.31	0.46	0.38 ^{>}	0.49	0.29 ^{<}	0.46
ACT score	23.62	4.04	22.68 ^{<}	3.88	23.83 ^{>}	4.05
Credits currently taking	15.04	2.43	15.60 ^{<}	1.86	14.91 ^{<}	2.52
Work characteristics						
Do not work	0.50	0.50	0.49	0.50	0.50	0.50
Work ≤20 hours/week	0.36	0.48	0.37	0.48	0.36	0.48
Work >20 hours/week	0.14	0.35	0.13	0.34	0.14	0.35
Class characteristics						
Fall 2009 semester	0.43	0.50	0.39	0.49	0.44	0.50
Spring 2010 semester	0.20	0.40	0.30 ^{>}	0.46	0.17 ^{<}	0.38
Fall 2010 semester	0.37	0.48	0.31 ^{<}	0.46	0.39 ^{>}	0.49
Professor A	0.35	0.48	0.38	0.49	0.34	0.48
Number of observations	1,087		201		886	

^aThe mean for the Grade in ECON 101 variable is only reported for those who did not drop ECON 101. The numbers of observations for this variable across the columns, respectively, are 998, 183, and 815.

^bThe > and < superscripts indicate that the mean is statistically different for students who enrolled in ECON 105 from that for students who did not enroll in ECON 105 (p -value = 0.05 or smaller, two-tailed tests).

may consist of students who took economics at a different university or who took ECON 101 before the start of our study period. About one-third of the students had taken an economics course in high school. Sixty percent of the students were in-state residents, and 13 percent were the first in their families to attend college. One-third of the students reported having ever used a tutor to help them with their studies (in any subject). The average ACT score among the students was 24, placing them at about the 75th percentile of students who took the ACT in 2008, 2009, or 2010.¹² About half of the students worked in addition to taking classes, with about one-third reporting working 20 or fewer hours per week and 14 percent working more than 20 hours per week.

The study period covers the fall 2009, spring 2010, and fall 2010 semesters. About 43 percent of the students in the study took ECON 101 in the fall 2009 semester, 20 percent took the course in spring 2010, and 37 percent took the course in fall 2010. Over the course of the study, two different instructors taught ECON 101 each semester. The binary variable *Professor A* is equal to 1 for one of these professors. Approximately one-third of the ECON 101 students had Professor A as an instructor.

There are several statistically significant differences in the characteristics of ECON 101 students who enrolled in ECON 105 and their peers who did not enroll in ECON 105. A higher proportion of the ECON 105 students were business majors, female, had previously used a tutor, and enrolled in the later semesters of our study. Fewer of the ECON 105 students were engineering majors. ECON 105 students had lower average ACT scores and were enrolled in slightly more credits than their peers, although the credit difference is small and roughly equivalent to the one-credit ECON 105 course.

Table 4 presents estimated marginal effects from a probit regression of *Enrolled in ECON 105* on the various student characteristics. The estimates indicate that after controlling for other student characteristics, females, those who have used a tutor before, and those taking more credits were more likely to enroll in ECON 105, while seniors, engineering majors, “other” majors (primarily education majors), first-generation college students, and those with higher ACT scores were less likely to enroll in ECON 105. Enrollment in ECON 105 was 12 points higher during spring 2010 than fall 2009, most likely because students in the later semesters heard about ECON 105 from their peers and from on-campus advising centers.

As with the raw mean differences reported in table 3, the estimates in table 4 suggest that students who enrolled in ECON 105 were likely weaker students than their peers who did not enroll in ECON 105 in that they had lower college entrance exam scores and were less likely to be seniors. Based on this difference, we expected that the students who enrolled in ECON 105 would have higher dropout rates and lower ECON 101 course grades than their peers, *ceteris paribus*.

EMPIRICAL FRAMEWORK

To assess the impact of ECON 105 enrollment on student outcomes in ECON 101, we used regression equations of the form:

$$Y = \beta_0 + \beta_1 \text{Enrolled in ECON 105} + \beta_2 \text{Class} + \beta_3 \text{Major} + \beta_4 \text{Background} + \beta_5 \text{Work} + \beta_6 \text{Course} + \varepsilon^{13} \quad (1)$$

TABLE 4
Enrollment in ECON 105 (Probit Regression)

	dy/dx ^a	z-stat
Class standing		
Freshman	—	—
Sophomore	−0.02	−0.70
Junior	−0.06	−1.31
Senior	−0.10*	−1.81
Major		
Social science	—	—
Natural science	−0.07	−1.45
Arts & humanities	−0.05	−0.81
Business	0.02	0.42
University studies	−0.03	−0.64
Engineering	−0.09**	2.00
Other	−0.14***	−2.49
Background characteristics		
Age (years) ^b	0.01	1.41
Female	0.10***	3.60
Single	0.00	−0.18
Taken prior econ in college	0.05	1.16
Taken prior econ in high school	0.00	−0.14
In-state resident	0.03	1.04
First-gen. college student	−0.06*	−1.70
Have ever used a tutor	0.04*	1.70
ACT score ^b	−0.01***	−2.94
Credits currently taking ^b	0.02***	4.13
Work characteristics		
Do not work	—	—
Work ≤20 hours/week	0.00	−0.11
Work >20 hours/week	−0.02	−0.63
Class characteristics		
Fall 2009 semester	—	—
Spring 2010 semester	0.13***	3.72
Fall 2010 semester	−0.01	−0.63
Professor A	0.02	0.92
Pseudo R-squared	0.10	
Number of observations	1,087	

^aReports the predicted change in the probability for a one-unit change in the independent variable at the mean. For discrete variables, reports the predicted change in the probability for a change from 0 to 1.

^bAll variables are binary with the exception of *Age*, *ACT Score*, and *Credits Currently Taking*, which are continuous variables.

* $p < .10$; ** $p < .05$; *** $p < .01$ (two-tailed tests).

where Y alternately represents *Dropped ECON 101*, a binary variable indicating whether the student dropped ECON 101 or, *Grade in ECON 101*, which measures the final course grade in percentage terms for students who completed ECON 101. *Enrolled in ECON 105* is a binary variable indicating whether the student enrolled in the ECON 105 recitation course. *Class* is a vector of binary indicators for the student's class standing, with the freshman variable omitted.

Major is a vector of indicators for the student’s major, with social science as the omitted indicator. *Background* is a vector of student characteristics including age, sex, relationship status (single versus other), indicators for whether the student had taken a prior economics class in college or in high school, indicators for whether the student was an in-state resident or a first-generation college student, and the student’s ACT score.¹⁴ The vector *Work* contains indicators for whether the student worked 20 or fewer hours per week or worked more than 20 hours per week, with “do not work” as the omitted category. Finally, *Course* is a vector of dummies indicating the semester the student took ECON 101 and which professor taught the course.

We also estimate variants of equation 1 to assess relationships between ECON 105 enrollment and the probability of later enrollment in either Principles of Macroeconomics or Principles of Microeconomics. In these regressions, *Y* represents a binary variable for enrollment in these courses. For the subset of students who did enroll in Principles of Macroeconomics or Principles of Microeconomics after completing ECON 101, we also estimated whether ECON 105 enrollment impacted their probability of dropout and final grades in these subsequent courses. In these regressions, *Y* alternately represents an indicator for whether the student dropped out of the principles class and the final grade earned in the principles class.

EMPIRICAL RESULTS

Our estimates of equation 1 are presented in tables 5 and 6. Table 5 reports the estimates of student performance in ECON 101, and table 6 reports the estimated coefficients on *Enrolled in ECON 105* for enrollment and course outcomes in Principles of Macroeconomics or Principles of Microeconomics.

Dropout Rates in ECON 101

The first column of table 5 reports the estimated marginal effects from a probit regression of *Dropped ECON 101* on our independent variables. The coefficient on the *Enrolled in ECON 105* variable is statistically insignificant in the regression, indicating no significant difference in the

TABLE 5
Impact of ECON 105 Enrollment on Outcomes in ECON 101

Dependent variable:	Dropped ECON 101		Grade in ECON 101	
	Probit ^a	PSM ^c	OLS	PSM
Enrolled in ECON 105	0.00 (−0.20) ^b	−0.02 (−0.41)	3.52*** (4.17)	4.09*** (2.60)
Number of observations	1,087	1,087	998	998

Note: Appendix table A1 presents coefficient estimates for other variables included in these regressions.
^aFor the probit regression, the table reports the predicted change in the probability for a change from 0 to 1 in *Enrolled in ECON 105*.
^bz-statistics (for the probit regression) and *t*-statistics (for the OLS and PSM regressions) are reported in parentheses.
^cFor the PSM estimates, the coefficients are obtained using nearest neighbor matching, and the *t*-statistics are obtained from bootstrapped standard errors.
****p* < .01 (two-tailed tests).

probability of attrition among students who did or did not enroll in the ECON 105 recitation course. As mentioned above, because the students who enrolled in ECON 105 were somewhat academically weaker than their counterparts who did not enroll in ECON 105, we expected them to have higher dropout rates than their peers. Based on this estimate, the ECON 105 class was a success. However, when we controlled for the systematic differences between the ECON 105 students and their peers using PSM (second column of table 5), the coefficient on *Enrolled in ECON 105* is statistically insignificant, indicating that the ECON 105 class did not impact attrition from ECON 101.

The other estimated coefficients from this regression are reported in the Appendix (table A1). Our estimates indicate that more advanced students were less likely to drop ECON 101 than their freshman counterparts, and majors in the natural sciences, business, university studies, and engineering were less likely than majors in the social sciences to drop ECON 101. Female students, single students, and first-generation college students were more likely to drop ECON 101, while students with higher ACT scores were less likely to drop the course. Students enrolled in the spring and fall semesters of 2010 were less likely to drop out than students enrolled during fall 2009, while students who took ECON 101 from Professor A were more likely to drop the course.

Grades in ECON 101

The third column of table 5 reports coefficient estimates of equation 1 while using *Grade in ECON 101* as the dependent variable. In the ordinary least squares (OLS) regression, the coefficient on *Enrolled in ECON 105* is positive and statistically significant, indicating that students who enrolled in the ECON 105 course earned 3.5-point higher grades than their peers who did not enroll in ECON 105. The coefficient on *Enrolled in ECON 105* in the PSM regression presented in the fourth column is consistent with this, indicating that once systematic differences between the ECON 105 students and their peers are controlled, enrollment in the ECON 105 course is associated with 4.1-point higher final course grades in ECON 101. Thus, ECON 105 enrollment is associated with just under a half-letter grade improvement in ECON 101.

The other coefficient estimates from the *Grade in ECON 101* regression are reported in the Appendix (table A1). The estimates indicate that sophomores and seniors earned higher grades in ECON 101 than did freshmen. Only natural science majors earned statistically different grades in ECON 101 than social science majors, with majors in the natural sciences earning 3-point higher grades than majors in the social sciences. In-state residents and students with higher ACT scores also earned higher final grades in ECON 101. Students who reported working more than 20 hours per week earned 2–3-point lower grades than students who did not work when they were enrolled in ECON 101. Grades earned in the spring 2010 semester were slightly lower than those earned in the fall 2009 semester, while those earned in the fall 2010 semester were slightly higher than those earned in fall 2009. Finally, although students who took ECON 101 from Professor A were more likely to drop ECON 101, those who persisted and finished the course earned 2-point higher grades than those who did not take ECON 101 from Professor A.

Enrollment, Dropout, and Course Grades in Subsequent Economics Courses

Of the 998 students in our sample who completed ECON 101, 373 went on to enroll in Principles of Macroeconomics and 183 went on to enroll in Principles of Microeconomics during our study

period.¹⁵ These represent the next courses offered in the economics sequence at SU, and ECON 101 is a prerequisite for these courses. If enrollment in ECON 105 increases student learning or interest in ECON 101, it could also boost enrollment, retention, and grades in these subsequent principles courses. Alternatively, if taking ECON 105 allows marginal students who would have otherwise failed ECON 101 to pass the class and move on to the principles courses, retention and grades in the principles courses may be lower among ECON 105 students than their peers.

Table 6 reports the estimated coefficients on the *Enrolled in ECON 105* variable in estimates of equation 1 that use *Enrolled* (in principles), *Dropped*, and *Grade* variables for the Principles of Macroeconomics and Principles of Microeconomics courses as the dependent variable in the regressions. As with the ECON 101 outcome regressions, we estimated the relationship between *Enrolled in ECON 105* and the outcome variables using probit, OLS, and PSM estimation techniques.

Turning first to the *Enrolled* regressions, 33 and 16 percent of the ECON 101 students went on to enroll in Principles of Macroeconomics or Principles of Microeconomics, respectively, during the subsequent semesters in our study. The estimated coefficients on *Enrolled in ECON 105* are positive, with both the probit and PSM estimates indicating that ECON 101 students who enrolled in ECON 105 were 6–9 percentage points more likely to enroll in Principles of Macroeconomics than their non-ECON 105 peers. However, these estimated effects are only significant at the 0.11 level. ECON 105 students were also more likely to enroll in Principles of Microeconomics, with the probit estimates indicating a 4-percentage-point higher probability of enrollment, and PSM estimates indicating a 15-percentage-point higher probability of Principles of Microeconomics enrollment among ECON 105 students relative to their peers. The probit estimate is significant at the 0.11 level, while the PSM estimate is significant at the 0.01 level.

TABLE 6
Impact of ECON 105 Enrollment on Outcomes in Subsequent ECON Courses

Course: Dependent variable:	Principles of Macroeconomics			Principles of Microeconomics		
	Enrolled	Dropped	Grade	Enrolled	Dropped	Grade
Mean:	0.33	0.09	74.01	0.16	0.16	81.10
Enrolled in ECON 105 (Probit/OLS) ^a	0.06 (1.59)	−0.01 (−0.51)	−1.33 (−0.91)	0.04 (1.56)	−0.08 (−1.32)	0.66 (0.26)
Enrolled in ECON 105 (PSM)	0.09 (1.53)	−0.02 (−0.33)	−1.41 (−0.51)	0.15*** (3.54)	−0.04 (−0.27)	6.52 (0.93)
Proportion who took ECON 105	0.20	0.24	0.25	0.20	0.26	0.28
Number of observations	1,137	373	339	1,137	183	154

Notes: Columns report estimated effects of *Enrolled in ECON 105* on the probability of enrollment, probability of drop, and final course grade in Principles of Macroeconomics and Principles of Microeconomics, respectively. Regressions include all independent variables listed in table 3. *z*-statistics (for the enrolled and dropped regressions) or *t*-statistics (for the grade regression and all PSM estimates) are reported in parentheses. For the PSM estimates, the coefficients are obtained using nearest neighbor matching and the *t*-statistics are obtained from bootstrapped standard errors.

^aThe *enrolled* and *dropped* regressions were estimated using probit, the *grade* regression by OLS. For the probit regressions, the table reports the predicted change in the probability for a change from 0 to 1 in *Enrolled in ECON 105*.

*** *p* < .01 (two-tailed tests).

In terms of class performance among the students who enrolled in the principles courses, none of the estimated coefficients on *Enrolled in ECON 105* are significant, indicating that students who enrolled in ECON 105 while they took ECON 101 had no better or worse outcomes in the principles courses than their ECON 101 peers who did not enroll in ECON 105.

CONCLUSION

In this article, we examine the attrition and grade impact of concurrent enrollment in a voluntary economics recitation class for students taking introductory economics. The estimates indicate that students who voluntarily enroll in a recitation class to complement their ECON 101 course are more likely to be business majors, females, and students who have used tutors to assist in their studies in the past. Engineering majors and students with higher ACT scores are less likely to voluntarily enroll in the recitation class. At least based on the ACT indicator, it appears that students who voluntarily enroll in recitation classes are somewhat academically weaker than their ECON 101 counterparts who do not choose to enroll in the recitation courses.

Despite being academically weaker students, students who enrolled in the recitation course did not have higher attrition from ECON 101 than their counterparts who did not enroll in the recitation class. In addition, raw means, OLS estimates, and PSM estimates indicate that students who enrolled in the recitation class had higher final grades than their ECON 101 counterparts. Although there is some evidence that students in the recitation courses were more likely than their peers to enroll in subsequent economics courses, the improved ECON 101 grades associated with enrollment in the recitation courses do not appear to carry over to grades or attrition in subsequent economics courses.

NOTES

1. The course is required for economics majors, business majors, and some engineering majors.
2. In their investigations of the issues pedagogy, Grimes and Nelson (1998) conducted controlled experiments to examine learning outcomes in issues-based versus traditional principles of economics courses. They found no significant difference in learning outcomes between the two pedagogical approaches but higher rates of course completion for students in the issues-based course.
3. Syllabi for the ECON 101, ECON 105, and ECON 305 courses are available from the authors.
4. An instrumental variables (IV) approach for controlling for self-selection into the ECON 105 class was also attempted, using the number of credits a student was enrolled in during the semester they took ECON 101 and a binary indicator for whether the student had ever used a tutor to help them with their studies (in any subject) to instrument for selection into ECON 105. Although these two instruments are related to ECON 105 enrollment, the tutor variable was also related to ECON 101 final grades. Nonetheless, the results were generally similar to those presented here, and are available from the authors.
5. Anderson (forthcoming) provides an excellent nontechnical overview of the PSM method. More technical presentations are in Rosenbaum and Rubin (1983) and Heckman, Ichimura, and Todd (1997).
6. There are several methods available to match treated and untreated individuals, including nearest neighbor matching with replacement (where each observation within the treated group is matched to the closest observation in the untreated group based on the propensity score), radius matching (where each observation within the treated group is matched to all observations within the untreated group with propensity scores within a given interval), and kernel-based matching (where each observation within the treated group is matched against all observations in the untreated group, but more weight

is placed on matches with closer propensity scores). Because the estimated average treatment effects were similar across each of these PSM methods, we report only the nearest neighbor matching results here.

7. Because this research involves the use of educational tests and surveys of human subjects, it was submitted for review by the SU Institutional Review Board (IRB) for the Protection of Human Subjects (Review Number: TS041510-EX), which determined that the study was exempt from further IRB review. All personal information was recorded using identification numbers rather than student names in order to protect the subjects' identities. In addition, all researchers engaged in this work took a research ethics and human subjects research training course prior to conducting the study.
8. The university studies group is SU's category for undeclared majors. The social science group includes anthropology, economics, political science, psychology, and sociology. The natural science group includes animal science, biology, biotechnology, cell biology and neuroscience, chemistry, earth sciences, environmental sciences, horticulture, land rehabilitation, land resources science, microbiology, rangeland ecology, physics, plant sciences, pre-veterinary medicine, sustainable foods and bioenergy, statistics, and mathematics. The arts & humanities group includes history, philosophy, art, English, environmental design, film and photography, liberal studies, media and theater arts, modern languages and literatures, music, music technology, and graphic design. The engineering group includes bioengineering, chemical engineering, civil engineering, computer engineering, computer science, construction engineering technology, electrical engineering, general engineering, industrial engineering, and mechanical engineering. The "other" group consists primarily of education majors.
9. The ACT web site for converting the scores is <http://www.act.org/aap/concordance/index.html>.
10. Unfortunately, we do not have information on whether students were repeat enrollees in ECON 101 if they enrolled for the first time prior to the beginning of our study (fall 2009).
11. We do not have information on the timing of student attrition from ECON 101.
12. National ranks for ACT tests are available at <http://www.actstudent.org/scores/norms1.html>.
13. Although it would be possible to also use the grade earned in ECON 105 as an explanatory variable in equation 1, we do not do this for two reasons. First, it would limit the analysis to only those students who enrolled in ECON 105, rather than all ECON 101 students. Second, because a significant portion of the ECON 105 course grade was based on attendance and performance on in-class group problems, there is very little variation in ECON 105 grades.
14. We also estimated models that included *ACT*Enrolled in ECON105* and *Female*Enrolled in ECON105* to assess whether the ECON 105 class had differential impacts based on students' ACT scores or gender, respectively. The coefficients on these interaction terms were statistically insignificant in all specifications, and the other variables' coefficients were qualitatively similar to those presented in the tables.
15. One hundred thirty-nine of the 998 students who completed ECON 101 subsequently enrolled in both Principles of Macroeconomics and Principles of Microeconomics during our study period. Thus, our enrolled-in-principles regressions have 1,137 observations.

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APPENDIX: TABLE A1

CONTROL VARIABLE COEFFICIENT ESTIMATES

	Dropped ECON 101		Grade in ECON 101	
	dy/dx	z-stat	dy/dx	t-stat
Class standing				
Freshman	—	—	—	—
Sophomore	−0.05*	−1.95	3.44***	3.71
Junior	−0.09**	−2.21	2.22	1.43
Senior	−0.09*	−1.82	7.30***	3.92
Major				
Social science	—	—	—	—
Natural science	−0.10***	−2.77	3.42**	2.31
Arts & humanities	−0.07	−1.36	−1.05	−0.53
Business	−0.10***	−3.03	0.74	0.53
University studies	−0.06*	−1.69	0.81	0.53
Engineering	−0.08**	−2.26	1.48	1.02
Other	0.01	0.11	2.06	0.84
Background characteristics				
Age (years) ¹	0.01	1.05	0.17	0.75
Female	0.05***	2.79	−0.42	−0.55
Single	0.04**	2.30	−0.78	−1.07
Taken prior econ in college	0.03	1.17	−1.34	−1.11
Taken prior econ in high school	−0.02	−0.86	0.57	0.76
In-state resident	0.00	0.15	1.47**	2.01
First-gen. college student	0.08***	3.32	−1.27	−1.25
Have ever used a tutor	0.01	0.42	−1.26*	−1.68
ACT score ¹	−0.01***	−4.36	1.68***	19.02
Credits currently taking ¹	0.00	−0.48	−0.04	−0.30

(Continued on next page)

APPENDIX: TABLE A1

CONTROL VARIABLE COEFFICIENT ESTIMATES (*Continued*)

	Dropped ECON 101		Grade in ECON 101	
	dy/dx	z-stat	dy/dx	t-stat
Work characteristics				
Do not work	—	—	—	—
Work ≤20 hours/week	0.03	1.60	−0.38	−0.51
Work >20 hours/week	0.04	1.55	−2.42**	−2.24
Class characteristics				
Fall 2009 semester	—	—	—	—
Spring 2010 semester	−0.05**	−2.16	−2.80***	−3.07
Fall 2010 semester	−0.03*	−1.73	1.28*	1.77
Professor A	0.04**	2.10	1.89***	2.72
R-squared	0.08		0.38	
Number of observations	1,087		998	

¹All variables are binary with the exception of *Age*, *ACT score*, and *Credits currently taking*.

* $p < .10$; ** $p < .05$; *** $p < .01$ (two-tailed tests).