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# The High Costs of Large Enrollment Classes: Can Cooperative Learning Help?

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**Abstract**

We examine the potential for cooperative learning activities to offset costs of large enrollment courses. We use a quasi-experimental research design to examine achievement and course perceptions in small and large enrollment sections of microeconomic principles. While large enrollment sections attain lower levels of achievement (measured by course score) than those with smaller enrollments, this effect is partially mitigated by use of cooperative learning. Furthermore, while students in large enrollment sections report lower levels of satisfaction and learning than students in smaller sized classes, the use of cooperative learning eliminates the negative effects of increased class size on student perceptions.

**Key words**: economics education, large enrollment classes, cooperative learning, pedagogy

**JEL code**: A2

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## INTRODUCTION

In recent decades, colleges and universities have responded to tightened budget constraints and the increased challenges of allocating scarce faculty time across a diverse range of research, teaching, and administrative responsibilities by increasing class size. The field of economics is no exception to this trend. In 1995, for example, average class size for principles courses taught at research universities was 162, but by 2001 the average size had increased to 185 students. Colleges granting only associate degrees saw even larger percentage increases as the average principles class size increased from 30 to 45 over this same period [Becker and Watts 2001, p. 449]. While more recent studies suggest that the increases in class size have leveled off to some extent in recent years [Watts and Schaur 2011], relatively large class sizes in principles courses remains an important strategy for many colleges and universities in managing enrollment fluctuations. Although large enrollment courses potentially reduce costs to higher education providers and – in some cases – may enable faculty to specialize in either research or teaching activities, academics have voiced many concerns related to large enrollment classes. Concerns include the effects that larger classes have on the choice of teaching methods and their efficacy, perceptions and behavioral responses of students enrolled in large classes, difficulties associated with administration and logistics in large enrollment classes, and students' evaluations of instructors of large classes. While such concerns have led instructors in other disciplines to incorporate techniques designed to facilitate student engagement, learning, and information retention into their pedagogical approaches [e.g., Cooper 1995; MacGregor 2000; Deslauriers et al. 2011; Ferreri and O'Connor 2013], most instructors of large introductory economics courses continue to primarily (or exclusively) utilize lecture-based instruction. Watts and Schaur [2011] report that – across institutional type – the median percentage of class time spent lecturing remained at 83 percent from 1995 through 2010 with few instructors at any type of institution making use of active teaching and learning methods. This fact is unsurprising given perceptions among economics instructors about the high cost of implementing active learning approaches and uncertainty about the success of such approaches in the economics classroom [e.g., Becker and Watts 2001; Salemi 2002; Herbert et al. 2003].[1]

To advance our understanding of the effectiveness of active learning approaches in large enrollment courses, the current study uses a quasi-experimental research design to examine whether cooperative learning techniques can mitigate some of the negative consequences of increased class sizes. Using data from both small- and large-enrollment principles of microeconomics courses (taught by the same instructor using identical class materials over the course of several semesters), we examine differences in student learning and perceptions about the course across sections that varied only in the usage of cooperative learning. We find that while large enrollment sections attain lower levels of achievement (as measured by course score) than those with smaller enrollments, this effect is at least partially mitigated by the cooperative learning treatment. Overall, students in large enrollment sections report lower average levels of satisfaction and learning than students enrolled in smaller sized classes. Comparing only the (large and small enrollment) sections engaged in cooperative learning activities reveals that the use of cooperative learning activities eliminates the negative effects of increased class size on student perceptions. The following section provides background information regarding the possible problems associated with large class size, as well as the potential for cooperative learning to moderate the problems experienced in large-enrollment class settings; this is followed by an outline of the data and methodological framework; We present the results from the empirical analysis and offer some concluding thoughts in the remainder of the paper.

## BACKGROUND

### Class Size and Post-Secondary Education

A large literature examines the connection between class size and student outcomes in post-secondary education [e.g., Marsh 1987; McKeachie 1980; 1990; Chatman 1997; Herbert et al 2003; Mulryan-Kyne 2010].[2] Although scholars readily acknowledge the potential benefits of large-sized classes (such as cost savings, efficient use of faculty time, large cohort pools from which to draw in forming study groups, etc.), much of the literature focuses on the perceived costs of increased class size. The most commonly-discussed concerns about large-enrollment courses center on the belief that such classes are less engaging than smaller classes, either because the teaching methods and class environment are inherently less conducive to capturing and sustaining students' attention or because students respond to the large class environment by choosing to disengage. It is often argued, for example, that instructors in large classes rely more heavily on lecture-based instruction, provide limited opportunities for discussion, and employ few other active learning pedagogical techniques. Even when discussion is incorporated into large classes, a larger class size reduces the amount of time that any one student can contribute to the discussion. Moreover, physical classroom environment factors including poor visibility of the instructor and/or projector screen or excessive noise in large lecture halls may exacerbate the difficulties students experience in paying attention. Other threats to student engagement in large classes come from the behavioral response of students. In particular, students may feel more comfortable missing class (or arriving late), yielding to distractions such as phones and computers, engaging in side conversations, falling asleep, remaining silent to avoid asking/answering questions in such an intimidating setting, or putting forth minimal effort when such behaviors are less conspicuous to instructors or peers. Since student engagement (in general) and active learning (in particular) have been shown to promote deeper understanding of the subject, improved critical thinking, increased information retention, and greater likelihood of persistence toward a degree, the consequences of reduced use of active learning strategies in large-enrollment classes are particularly problematic.[3]

In addition to concerns about reduced student engagement, the literature on class size frequently discusses administrative challenges that may inhibit student learning in large-enrollment courses. Recording attendance may prove difficult without taking up precious class time or utilizing aides or electronic response devices. Economists believe that incentives are important in behavioral decisions. If attendance is not taken (due to these difficulties), then students may be less likely to attend class.  Student attendance, however, has been demonstrated to be positively correlated with achievement [Alpert et al. 2012; Arulampalam et al. 2012; Cohn and Johnson 2006]. Despite evidence suggesting that students benefit from graded homework assignments [Emerson and Mencken 2011; Grodner and Rupp 2013; Artés and Rahona 2013] and receiving substantive feedback throughout the learning process [Austin 1976; Page 1958], high time-cost of grading in large-enrollment classes potentially places limitations on the instructors' choice of assignments. For example, instructors may reduce the frequency of assignments and exams or rely more heavily on objective homework/exam questions instead of assigning essay questions or requiring oral presentations, response papers, or substantial writing assignments.

Lastly, the potential for large class size to limit interaction between students or between students and the instructor (in or outside of the classroom) presents challenges to building a sense of community in the classroom. This is especially problematic from the standpoint of university administration, since theory and empirical evidence supports a positive role for peer and faculty interactions in promoting satisfaction with institutional selection (i.e., ‘fit’ with one’s university), intent to return in subsequent semesters, and persistence toward educational goal attainment [e.g., Astin 1984; Tinto 1975; Pascarella and Terenzini 1991; 2005].

The various concerns surrounding large enrollment classes ultimately relate to questions regarding impacts of class size on student performance. With respect to classes in general, a number of researchers have found a negative relationship between class size and grades. Using data for all undergraduate classes in a single university during a given semester, Johnson [2010] finds a consistent negative effect of class size on grades where the probability of achieving an “A” is most substantially reduced with a smaller (negative) effect on the probability of receiving a “C” or higher. Similarly, Kokkelenberg et al. [2008] use a very large sample (998,898 observations) of all undergraduate students taking courses at a “highly selective research institution” from 1992 to 2004 and – even after controlling for student characteristics, examining various ranges of class sizes and specifications, and a separate specification with student fixed effects – the authors find a consistently negative relationship between class size and grades. This effect was more pronounced for smaller class sizes (i.e., the results are consistent with large diseconomies of scale moving from 20 to 40 students and smaller diseconomies of scale moving from, say 80 to 100 students). Bandiera et al. [2010] find similar non-linear negative effects for masters of science students in the UK. Studies specific to economics courses find mixed results. Stratton et al. [1994] find no statistically significant relationship between class size and course grade in principles of economics classes. Arias and Walker [2004] find significantly better performance (approximately 3 percentage points) on exams for students in a principles survey course with small enrollment than in otherwise identical large enrollment sections of the course. Further, Raimondo et al. [1990] examine students completing principles and intermediate theory courses in either micro or macroeconomics and find that students who completed their macro- (micro-) principles course in a large lecture setting received lower (equivalent) grades in intermediate macro (micro) than students who completed their principles course in a small class setting.

Other research has focused on a different measure of learning – the Test of Understanding in College Economics (TUCE). Using a large sample of student data from 53 different colleges and universities, Kennedy and Siegfried [1997] show that class size is unrelated to students' performance on the TUCE (when looking at class averages of post-course scores or at the change in average TUCE scores over the course of the semester). Saunders [1980] finds no consistent relationship between class size and performance on the TUCE when the test is administered immediately after completing a 2-semester principles sequence or several years after completion of the sequence, suggesting that student achievement and the retention of information tested on the TUCE are not measurably affected by class size. Although not the focus of the study, Lopus and Maxwell [1995] find that class size is positively correlated with performance on a post-course TUCE after controlling for the percent of the class time spent lecturing and other environmental and individual characteristics.

In spite of the mixed findings on class size and student performance, substantial evidence suggests that students dislike large classes [e.g., Feldman 1984, McConnell and Sosin 1984, DeCanio 1986, Siegfried and Walstad 1990, Bedard and Kuhn 2008].[4] Perhaps this is because students perceive they learn less in large enrollment settings. Using institution wide data across 24 disciplines, Cheng [2011] finds an overall negative relationship between class size and student self-reported learning, although disaggregation of the results reveals that the significant relationship only holds for eleven of those disciplines (including Economics). Other research drawing on course evaluations also reveals falling student satisfaction as enrollments rise. For example, using student evaluation data for all economics courses taught at University of California- Santa Barbara between 1997 and 2004, Bedard and Kuhn [2008] find that class size is negatively related to students' perceptions about teacher effectiveness even after controlling for instructor and course fixed effects. Such results, however, are not relegated to economic students nor to those studying in the U.S. Using a similar approach, Mandel and Sussmuth [2011] find that this negative relationship also holds for economics students at the University of Munich. Measuring student satisfaction by whether a student would recommend the course and/or instructor, Cheng [2011] finds a negative relationship between satisfaction and class size when evaluated across 24 disciplines at University of California- Irvine. When disaggregated, however, only four disciplines (Sociology, Political Science, Computer Science and Engineering, and Mechanical and Aerospace Engineering) generate a significant negative relationship across both recommendation measures.

Student surveys help to shed light on the reasons for such negative perceptions. Students queried at the end of a semester during which they took at least one large enrollment business or economics course at University of Nebraska- Lincoln indicated dislike for several aspects of large enrollment courses [McConnell and Sosin 1984]. Students seemed especially concerned about greater difficulty in staying motivated to learn and in paying attention, fewer opportunities for interaction with the instructor, limitations placed on homework and writing assignments, faster/more rigid pace, and inability to hear/see the instructor or teaching materials. The dislike of large classes was associated with concerns about grades, as well. Very few students (9% of those surveyed) agreed (or strongly agreed) that they achieved higher grades in large classes than in smaller ones. It also appears that students' dislike of large enrollment economics courses may translate into lower interest in the subject, negatively affecting students' intentions to continue study in the field of economics. Maxwell and Lopus [1995] show that the probability of enrolling in future economics classes is reduced when class size increases; similarly, Becker and Powers [2001] find that large class size is associated with a higher likelihood that a student will withdraw from an introductory economics course.

## Cooperative Learning in Large Enrollment Courses

The difficulties associated with effectively teaching (and the negative student perceptions of) large enrollment courses may motivate some instructors to adjust their pedagogical approaches to overcome real or perceived challenges. Cooperative learning approaches encompass several key elements that seem especially promising for this purpose. Essentially, "cooperative learning is a highly structured form of group work that focuses on the problem solving that – when directed by an effective teacher – can lead to deep learning, critical thinking, and genuine paradigm shifts in students' thinking" [Millis 2010, p. 5]. To be classified as cooperative learning, which is distinct from "group work" or "collaborative learning," activities incorporate elements of positive interdependence, individual accountability, equal participation, and simultaneous interaction [Johnson et al. 1998; Kagan 2009]. By providing a formative assessment of individual performance and fostering the belief among students that group members "sink or swim together," cooperative learning activities potentially reduce the likelihood that students in large enrollment courses feel comfortable missing class, minimizing their efforts, or yielding to distractions. Moreover, to maintain equal participation and simultaneous interaction, cooperative learning activities formally specify norms for participation (e.g., allocating the order of turns in a group activity), divide up group tasks into individual responsibilities, and ensure that all students are conversing or are otherwise fully engaged in tasks during the entire activity rather than remaining passive observers [Kagan 2009].

Not only does this structure further reduce the opportunities to free-ride on the efforts of other classmates, it may also help focus and sustain students' attention on class activities for longer periods. As such, cooperative learning activities potentially improve student perceptions about large enrollment courses, facilitate student engagement, increase student learning and retention, and foster a greater sense of community in these environments.

Limited information exists on the effects of cooperative learning in large enrollment classes. Vreven and McFadden [2007] investigate the impact of cooperative learning (specifically, think-pair-share activities) on student achievement and motivation in a large, time-compressed introduction to psychology course. They find that no significant difference exists in achievement between a control group involved in individual in-class activities and a treatment group engaged in similar in-class activities but completed in cooperative groups of two to five students. Motivation, on the other hand, differed with a significantly larger decrease in motivation of the treatment group over the three week term of the course. To our knowledge, no study of cooperative learning in economics has examined the efficacy of the cooperative learning intervention in the large enrollment environment. Studies of the efficacy of cooperative learning in economics more generally (with exclusively small enrollment sections) report mixed results. Marburger [2005] compared student performance for two principles of microeconomics cohorts – one employing traditional lecture techniques and the other cooperative learning exercises which substituted for lecture content. Results provide evidence of enhanced performance on specific assignments as a result of the treatment but no significant difference in the percentage of questions students answered correctly on the course final exam. Yamarik [2007] used a similar treatment/control research design to that employed by Marburger in order to investigate the efficacy of cooperative learning in an intermediate macroeconomics course. Cooperative learning exercises integrated key elements of successful cooperative learning and were completed in groups which met repeatedly over the entire semester, both in and outside of class. In the cooperative learning treatment, a total of nine class sessions were fully dedicated to students working together to answer a series of questions based on readings provided in advance and problem sets were the basis for group work outside of class. Results suggest that students in the cooperative learning class performed better on examinations, a difference attributed to greater student-instructor interaction, increased group studying, and enhanced interest in the course material. Finally, Emerson et al. [2015] employ a semester-long series of think-pair-share exercises in relatively small principles of microeconomics classes to determine whether this specific cooperative learning intervention affects student achievement. An interesting and important difference between the Marburger and Yamarik studies and the Emerson et al. study is that the control group in the later study was exposed to individual, in-class problem solving as opposed to traditional lecture. As such the Emerson et al. study is a "second generation" type study where by researchers attempt to isolate the channel through which the intervention may function. In comparison to individual problem solving, cooperative think-pair-share exercises result in no significant differences in student achievement. In spite of these mixed findings on the effects of cooperative learning activities in economics, we believe that given the challenges posed by large enrollment classes and the very nature of cooperative learning exercises, cooperative learning may well prove beneficial in the large enrollment setting. These possibilities motivate the current study.

## DATA AND METHODOLOGY

Study participants were enrolled in one of five sections of principles of microeconomics at a nationally ranked university taught by one of the study investigators during the 2011-2012 and 2012-2013 academic years. The class sections are distinguished by their size, with three relatively small sections (with enrollments ranging from 41 to 45 students) and two large sections (enrolling between 163 and 174 students).[5] All sections met between 9:30am and 1:45pm on Tuesdays and Thursdays for 75 minute periods and used identical syllabi and textbooks. Over the entire semester, students in all classes participated in 12 problem-solving exercises covering topics of comparative advantage, supply and demand, price controls, elasticity, utility maximization, production and profit, short and long run competitive equilibrium, monopoly, game theory, monopolistic competition, and externalities.[6] Importantly, however, in order to examine the extent to which negative class size effects may be mitigated by a cooperative learning intervention, this study utilizes a quasi-experimental research design where the materials, exercises and assessment instruments for all participating sections are identical except for the nature of the problem-solving process employed for the in-class practice exercises. When registering for classes, students were unaware that they were enrolling in a study section much less the pedagogical approach of the section in which they enrolled. Students in the control or independent problem solving sections (both large and small) were provided 8-10 minutes to individually complete a problem related to material covered in class. At the end of this time, the instructor presents the answer so that students may check their understanding. Students in the cooperative think-pair-share (treatment) sections also begin by spending 8-10 minutes individually completing the same problem. Thereafter, they are paired with a classmate[7] and are instructed to methodically take turns presenting answers to different components of the problem to their partner. Students are encouraged to ask for clarification if they do not understand their partner's explanation. At the end of this pairing and private sharing stage, students are randomly called upon by the instructor to share their answer to a component of the problem with the entire class. This public sharing process continues until students fully present all parts of the problem. An example think-pair-share problem and instructions associated with the topic of comparative advantage is provided in the appendix.

To empirically investigate the extent to which cooperative learning may mitigate potentially negative effects of large class sizes on learning, we use an educational production function approach that is standard in the literature [see, e.g. Siegfried and Fels, 1979]. Student learning is a function of a vector of student-specific characteristics (*X*), and indicators for large enrollment class and the cooperative learning intervention:

$$Student\ learning = (\alpha + \delta cooperative\ learning + \gamma class\ size + \delta cooperative\ learning * class\ size\ + \boldsymbol{X\beta} + u) \quad (1)$$

where *X* includes demographic characteristics (sex, age, race), measures of aptitude (standardized SAT score, whether taken high school economics, whether repeating the course), a proxy for interest (whether a business major for which principles is required), and additional behaviors which are likely to impact performance (number of absences and course load). Student demographic and academic information are collected via a survey administered on the first day of class. The registrar's office provided available SAT and ACT scores.[8,9] Observed student absences are recorded throughout the semester.

We gauge student learning with two measures: (1) a Test of Understanding in College Economics[10] 'gap-closing' measure defined as the difference between post- and pre-course TUCE scores expressed as a percentage of the maximum possible point improvement available (based on the students' pre-course TUCE score) and (2) course score. The pre-TUCE exam was administered on the first day of class prior to any instruction; the post-TUCE exam was administered on the final day of class after all instruction was complete. The TUCE gap-closing measure provides a relative assessment of performance improvement. This measure avoids potential downward biases from using an absolute change in TUCE which would arise when students perform strongly on the pre-TUCE. The course score reflects the percent of the total possible points (550) earned by students through performance on a final exam, two midterms, three quizzes, six homework assignments, and the post-TUCE. Each homework assignment, quiz, and exam consisted of a combination of true/false, multiple choice and problem/essay questions.[11]

Because the TUCE exam is comprised of 33 multiple choice questions, using it as a measure of learning raises issues of validity and empirical methodology. Becker [1997] suggests that the limiting nature of the fixed-response structure of the TUCE is not likely to lead to an accurate assessment of learning. However, the TUCE remains the only standardized, nationally recognized instrument which attempts to measure student learning in economics at the college level. Another common criticism of administering standardized tests is that they are not accurate measures of student understanding if the students are not motivated to perform well on them [Wehrs, 1978]. We incentivized the 33 question pre-TUCE exam by awarding a bonus point for each correctly answered question which was added to overall points earned during a semester.[12] The post-TUCE counted as 33 points out of the total 550 potential points for the semester.

It is important to note that use of post-pre measures raises the potential for sample-selection bias if students who do not take either the pre- or the post-TUCE are systematically different from those who take both exams [Becker and Walstad, 1990]. Also, (theoretically) the course score ranges from 0 to 109 and the gap closing measure ranges from $-\infty$ to 1; in our sample course scores range from 1.6 to 101 and the gap closing measure ranges from -0.38 to 1.00. As such, the measurement of learning constructed via the course score or gap closing calculation generate measurements which are censored [Siegfried and Fels, 1979). The student's course score as a measure of learning, while not nationally tested and standardized, provides an avenue for avoiding the selection problem since all students enrolled in the course are assigned a course score at the end of the semester. Further, the course score is often used by economic education researchers and thus provides a common achievement measure allowing for comparison across studies. Since the results are robust to controlling for selection using a Heckman two-step procedure and to using Tobit estimation[13], only the OLS results are presented below.

Tables 1 and 2 (a-d) provide definitions and summary statistics, respectively, of variables included in this study. Students in the small and large enrollment sections were statistically similar on most dimensions (e.g., gender and racial composition, average SAT scores, proportion of business majors, and number of absences) with the exception that students in the large enrollment sections tended to be slightly younger on average, were less likely to be repeating the course, and tended to complete more of their homework assignments in groups (Table 2b). Similarly, on most dimensions, the cooperative learning and independent problem-solving sections were statistically equivalent except that the independent problem-solving sections were constituted of a larger fraction of males and a larger proportion of these students had taken economics in high school (Table 2c). Considering the large enrollment subsample, students in the large enrollment cooperative learning sections completed fewer homework assignments in groups, consisted of a smaller fraction of males, and were less likely to have taken a high school economics course than those in the independent problem solving large enrollment sections. On all other dimensions, the cooperative learning and independent problem solving large enrollment subsamples were statistically identical (Table 2d).

Student knowledge of economics at the beginning of the semester (as measured by the unconditional mean of students' pre-course TUCE scores) does not statistically differ across any of the comparison groups (large and small enrollment, cooperative learning and independent problem solving or cooperative learning and independent problem solving within the large enrollment sections). Similarly, the unconditional mean of post-course TUCE scores, the TUCE gap-closing measure and course scores do not statistically differ across any of the groups. See Tables 2b-2d.

(Tables 1 and 2 here)

## RESULTS AND DISCUSSION

### Student Achievement

Estimation results for equation (1) are presented in Tables 3 and 4 for the TUCE gap-closing and course score measures of student learning, respectively. We control for gender, age, race, student ability (as measured by SAT standardized scores), class size, the nature of the in-class exercises (cooperative vs. independent problem solving), whether the student is repeating the course, whether the student had taken economics in high school, the students' choice of major, number of absences during the semester, the students' course load and an interaction term between the class size and cooperative indicators.

The variables of interest for this study are the large enrollment, cooperative learning, and interaction indicators. We find no direct effect of class size on TUCE performance, but we do find that student course scores are 6 percentage points lower for those in the large class sections. The negative coefficient on class size suggests that students attain lower levels of achievement in large enrollment courses. However, we find that being enrolled in a cooperative learning section of a large enrollment course mitigates the negative learning effect of the large class size as it raises course scores by nearly 5.8 percentage points (relative to a large enrollment section with individual problem solving). Interestingly this suggests administration of cooperative learning activities (as compared to independent problem solving) may off-set some of the costs of large enrollment classes.

According to the results for the TUCE gap-closing measure (Table 3), students with (10 percent) higher SAT scores demonstrate higher learning gains (of more than 4 percent) over the course of the semester, while students who are repeating the course fare (16 percent) worse. When examining course scores (Table 4), minority students earn grades that are 4 points lower. While, again, those with higher aptitude perform better (by nearly 4 percentage points) in the course. Across both learning measures, students with a greater number of absences exhibit lower achievement; each absence generating a decrease in course score by over 3 percentage points. These results are consistent with previous studies.

(Tables 3 and 4 here)

**Student Perceptions**

A comparison of student perceptions across sections of principles of microeconomics (that differ both in terms of class size and in terms of the pedagogy utilized) complements the preceding analysis of class size effects on student achievement in several ways. First, although it is essential to consider the effect of class size on student performance on assessments (e.g.,TUCE) and course scores, these traditional achievement measures may not wholly capture student learning or fully reflect the quality of education from students' perspectives [Pike 1996; Bedard and Kuhn 2008; Cheng 2011]. For example, some students tend to perform extremely well (or very poorly) on assessments irrespective of their true grasp of specific course content. Alternatively, students may perceive the course content or class activities to be especially valuable (or fairly useless) outside of the classroom regardless of their performance on related assignments/assessments. As such, students' impressions about the quality of instruction, evaluation of the course overall, and self-reported measures of learning, provide a more holistic picture of the educational outcomes than achievement data examined in isolation. Second, students' reported level of academic satisfaction is relevant to educators and administrators even beyond the inherent interest in better understanding student learning and factors that influence the quality of education. In particular, academic satisfaction influences student recruitment and retention, determines (to a large extent) alumni involvement and giving, and affects faculty performance evaluations, tenure and promotion decisions, and teaching awards [e.g., Tinto 1975; Aitken 1982; Pascarella and Terenzini 1991; 2005; Clotfelter 2003; Bedard and Kuhn 2008; Carrell and West 2010; Cheng 2011; Mandel and Sussmuth 2011].

As discussed above, substantial empirical evidence supports the claim that most students tend to dislike large classes. Several studies have suggested, however, that these negative perceptions of large classes often result from the ineffectiveness of large class instruction rather than the size of the classes themselves. In other words, these studies indicate that instructional quality – not class size per se – is most important in students' perceptions about the overall learning experience [e.g., Mirus 1973; Wulff et al. 1987; Litke 1995]. For example, over a three year period, Wulff et al. [1987] administered approximately 800 surveys with open ended questions to students enrolled in large sections of lower division classes at the University of Washington. Their analysis of student responses indicated that these students generally preferred classes with 75 or more students, but they disliked the large classes with “boring instructors” or “boring lectures” that lack discussion or interaction between the professor and students (or discussion and collaboration among students). Fortunately, the quasi-experimental design employed in the current study enables us to shed additional light on the importance of pedagogical approach in influencing students’ perceptions of large classes. In particular, we are able to compare student perceptions across small and large principles classes taught by the same professor using two different pedagogical approaches – one active learning approach utilizing cooperative learning activities and one less interactive pedagogical approach utilizing independent problem solving.

We examine whether students’ interaction with faculty and other classmates, interest in economics, perceived value of in-class exercises, self-reported measures of learning, and overall perceptions of the course differed across the small and large sections. Specifically, we administered surveys to students on the first and last days of class and asked them to describe their interest in the subject of economics and intent to take additional courses in economics (other than principles of macro, which is required for most of the students enrolled in principles of micro at the study institution). On the end-of-semester survey, students were also asked to compare the interaction level (with other students and their professor) in this course to interaction levels in their other courses. Students were further asked to identify which component of the course (in-class activities, homework, quizzes, etc.) was most/least valuable to their understanding of course content. Finally, students were asked a series questions similar to those traditionally found on faculty teaching evaluations to measure their overall perceptions of the course. In Table 5a, we summarize student responses to these questions separately for large and small classes engaged in independent problem-solving. In Table 5b we repeat this analysis for large and small classes engaged in cooperative learning activities.

Comparison between the large and small sections engaged in independent problem-solving reveal numerous differences in students' experiences and course perceptions (see Table 5a).[14] While students enrolled in large sections reported a significantly lower level of interaction with the professor (2.47 vs. 3.84 on a Likert-type scale where 10 = great deal and 1 = not at all) than did their small enrollment counterparts, they reported greater levels of interaction with their peers (measured in absolute terms and relative to other courses). As compared with students in the small enrollment sections, students in the large enrollment sections also reported a statistically greater increase in the number of classmates with whom they had contact, the number of classmates they counted as acquaintances, and the number of classmates they counted as friends over the semester. A substitution of peer for instructor interaction could be at play; however, they may also simply have had more peers with whom to interact. While perhaps beneficial in its own right,[15] the increased peer interaction in large classes did not translate into greater course satisfaction or perceived learning. On the contrary, when asked to rate their overall course satisfaction on a scale of 1-10 (with 1 meaning "not at all"; 10 meaning "extremely well"), students in large sections reported lower levels of course satisfaction than students in smaller sections (4.53 vs. 6.41). Students in large enrollment sections also reported lower average ratings for the extent to which the instructor stimulated their interest in the subject (2.79 vs. 3.50 on a Likert-type scale where 5 = strongly agree, 3 = neither agree nor disagree, and 1 = strongly disagree) or their thinking (3.21 vs. 3.75) and reported lower levels of agreement with the statement, “I learned a great deal from this course” (3.34 vs. 3.94 on the same Likert-type scale). Although students in small classes reported negligible decreases in their likelihood of taking optional economics courses in the future (and small increase in their interest in economics) over the course of the semester, students in the larger sections reported significant reduction in their interest in economics and likelihood of taking additional economics courses. In summary, Table 5a indicates that among students engaged in less active learning (i.e., students who completed independent problem solving exercises), students in large enrollment sections experienced less satisfaction, less interaction with the professor, less stimulation of their interest and thinking, but greater levels of interaction with peers than their counterparts in smaller classes.[16]

Comparing Table 5a to Table 5b, differences in perceptions of students in large and small enrollment classes with independent problem solving stand in sharp contrast to similar comparisons across large and small enrollment sections for students who were engaged more actively during class time (i.e., participating in cooperative learning exercises). Specifically, for students participating in cooperative learning exercises, there were almost no statistically significant mean differences for the qualitative outcomes. In other words, when students were engaged in more active learning, the increased class size made little difference to student satisfaction or perceived learning.[17] Taken together, the results presented in Table 5 (a-b) are consistent with a role for cooperative learning exercises in mitigating the negative effects of increased class size on student perceptions.[18]

(Tables 5a and 5b here)

## CONCLUSION

This study contributes to a growing literature exploring the effects of large enrollment courses on student achievement and course perceptions. In particular, we extend our understanding of the efficacy of active learning techniques in the large enrollment setting. Our study addresses existing gaps in the literature by conducting a quasi-experimental study across large and small sections of a principles of microeconomics course. Comparing large and small enrollment classes divided between a treatment group engaging in a think-pair-share problem-solving process to a control group engaging in independent problem-solving allows us to observe any potential differential effects of the treatment between small and large enrollment sections of the same course.

Our results suggest that negative effects of large class enrollments may be offset by incorporating cooperative learning activities. Since students engaging in independent problem solving in a large class may encounter additional distractions while trying to listen to the instructor explain answers or may be reluctant to ask the instructor clarifying questions in such an intimidating environment, discussing the answers privately with a partner and engaging in the group sharing process may be especially conducive to learning in large class settings. Our results also suggest that cooperative learning has the potential to mitigate the negative effects of increased class size on students' course perceptions. Consistent with the existing literature, we find that students in principles of microeconomics courses generally dislike larger classes, find such classes less interesting, believe they learn less in them, and become less interested in the field of economics after completing a principles class in a large enrollment section. These differences in students' experiences and perceptions emerged, however, only for sections that were engaged in less active, independent problem solving. Among students who were engaged in more active cooperative learning activities, students in large and small enrollment sections reported statistically similar levels of satisfaction, interest, and intent to take additional economics courses in the future.

Positive findings for cooperative learning interventions from studies comparing cooperative learning to lecture in small enrollment courses suggest that a comparison between small and large enrollment courses with similar treatment/control groups may prove equally favorable for gains associated with cooperative learning. This, however, is not the comparison being made in the current study. An important point to emphasize is that this study, like Emerson et al. [2015], attempts to isolate the cooperative component as opposed to using lecture as the comparison control class. The amount of time in which students were engaged in some type of problem solving, rather than listening passively to an instructor, was the same across all (control and treatment) sections included in the study. As such, any outcome differences we do (or do not) identify are attributable to the cooperative group interaction and not the in-class exercises themselves. Our findings speak specifically to the efficacy of the cooperative component of in-class exercises and suggest that they mitigate some of the negative achievement effects associated with large enrollment classes in comparison to large enrollment classes with individually completed in-class exercises (as opposed to a comparison group of large enrollment classes employing lecture alone). Further, given our research design, we are not in a position to make any statement regarding the relative efficacy of the cooperative learning think-pair-share and lecture-based approaches. Although, one might expect that any differences in student achievement between the two would likely be in the same direction and of potentially larger magnitude than those estimated here.

While considering the implications of our findings, it is also important to note that incorporating a greater extent of cooperative group interaction into a principles course could yield substantially different (possibly larger) cooperative learning effects. In this study, the in-class exercises account for a relatively small portion of the overall class time (2-3 hours of a 40-hour course) and – for the cooperative learning sections – the group interaction component of the exercises accounts for a small part of the total time spent working exercises in-class (less than 1 hour). An instructor could create even more opportunities for cooperative group interaction throughout the semester by introducing additional think-pair-share problems or integrating more complex cooperative learning activities into the course (e.g., note-taking pairs, send-a-problem, jigsaw). We are unable, however, to speak to the specific effects of such added group interaction opportunities except to say that they warrant further investigation. Certainly, just as studies of alternative cooperative learning exercises merit further investigation, so does research into the efficacy of other active learning pedagogies in the large enrollment setting (e.g., personal response devices, classroom experiments, just-in-time-teaching, etc.). And, of particular interest, are studies into the relative efficacy of different active learning approaches (as opposed to the majority of the current literature that compares these interventions to chalk-and-talk).[19]

**NOTES**

[1] Machemer and Crawford [2007] offer a variety of explanations for this observed behavior including reluctance to crowd out already scarce class time, concerns about losing control of the classroom, and concern that students have inadequate prerequisite skills for functioning together in team-based activities.

[2] The discussion that follows draws heavily on the work of these authors. Although a discussion of the substantial, but mixed, evidence regarding class size (and effectiveness of initiatives to decrease class size) in primary and secondary schools is beyond the scope of this paper, Hanushek [2002] and Krueger [2002; 2003] provide detailed summaries of the existing literature.

[3] See Pascarella and Terenzini [2005] and references therein for a discussion of the benefits of active learning.

[4] Despite the frequent negative responses of students to large classes, other evidence suggests that students actually prefer large classes [e.g., Mirus 1973, Wulff et al. 1987, Litke 1995]. These findings suggest that instructional quality – not class size per se – may be most important in students' perceptions about the overall learning experience. We revisit this point in the results section of the paper.

[5] Note that the useable sample is somewhat smaller than the total enrollment in the classes studied. Several factors contribute to the difference. First, some students (88 across five sections) did not agree to participate in the study by not completing the IRB consent form and thus their data cannot be used in this research. Likely due to the greater anonymity and weaker connection felt to classmates and the instructor, participation rates were lower in the high enrollment sections. Second, not all students completed the course and thus did not have either a final course score or post-TUCE score – or both. Third, only students for whom the full set of student characteristics was available are included in the study. For example, not all students took either the SAT or ACT and students without either score on record (17 students for the otherwise usable sample) were dropped from estimation due to these missing aptitude measures.
[6] Via Blackboard students in all sections were also provided problems associated with efficiency and market failure but, due to time constraints, they were not part of the in-class problem solving process.
[7] The first pairing is randomized at the beginning of the semester and students are assigned a seat in class next to their partner. Thereafter, students spend the rest of the semester working the cooperative learning exercises with the same partner. The student who initiates the sharing process alternates across problems over the semester.
[8] Becker and Powers [2001] argue against using student provided data for aptitude measures due to their unreliability. Further, Maxwell and Lopus [1994] demonstrate that student self-reporting of SAT scores may suffer from systematic reporting bias. Such nonrandom reporting would produce biased estimates of the relationship between student achievement and educational inputs.
[9] Where both SAT and ACT scores are available, the student's SAT score is used. Where only ACT scores are available, these scores are converted to SAT equivalents using http://www.act.org/aap/concordance/. For expositional simplicity, we refer to these measures as SAT scores whether they are original or converted.
[10] The TUCE is a standardized test of economics developed in partnership with the Council for Economic Education. It is nationally normed and contains 33 multiple choice questions targeting either introductory microeconomics or macroeconomics knowledge.
[11] While quizzes and exams were completed individually, students were allowed to complete any of their homework assignments in groups of up to four students, with all group members receiving the same grade. Students were free to create their own homework groups and to change groups (or opt not to work in a group) throughout the semester as they chose.
[12] In addition to the pre-TUCE extra credit, students were also incentivized to attend class with extra credit points for two or fewer absences and to complete the Jung Typology (personality type) Test.
[13] We direct readers interested in additional examples of the use of Heckman and Tobit procedures (and other relevant econometric techniques) in economic education research to the Online Handbook for the Use of Contemporary Econometrics in Economic Education Research at https://www.aeaweb.org/committees/AEACEE/Econometrics_Handbook/index.php.
[14] These differences are simple differences in means.
[15] Theoretical and empirical findings support a positive role for peer and faculty interactions in promoting satisfaction with institutional selection and retention, as well as persistence toward educational goal attainment [e.g., Astin 1984; Tinto 1975; Pascarella and Terenzini 1991; 2005]. Of particular relevance here are Pascarella and Terenzini's [2005] findings that interaction with peers (especially that which reinforces and extends classroom activities) is "the dominant force" behind gains in students' personal development (p. 121 and 249).
[16] Students in the large enrollment, independent problem solving section also completed more homework assignments in groups (Table 2d). Thus, it is possible that homework groups drive the increased interaction with peers for this subset of students.
[17] The single exception pertains to student interaction with the professor. In particular, students in large classes reported a significantly lower level of interaction with the professor (2.60 vs. 3.76) than did their small enrollment counterparts.
[18] It may also be instructive to consider student perceptions of the in-class exercises themselves. Students generally seem to find the in-class exercises more helpful than not even though the fraction of the students identifying the in-class exercises as most or least valuable activities did not differ between the treatment and control sections. Across all of the subgroups (treatment and control, large and small enrollment, treatment and control within the large enrollment sections), nearly half of the students named the in-class exercises as one of the most valuable activities and less than 15% named it as one of the least valuable.

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Appendix

**Principles of Microeconomics**
**Comparative Advantage Exercise**

The following exercise is designed to put the concept of comparative advantage into practice.

Cooperative Learning Class Instructions:

You will have 8-10 minutes to complete the following question on your own. When time is called, you will have 5 minutes to pair up with a classmate and compare your answers, resolving conflicts and enhancing incomplete answers. Students will take turns presenting the answers to each part of the problem and seeking feedback from their partners. The student in the pair that has the first letter of their last name closer to A in the alphabet will present his/her answers to parts a and b, seeking feedback from his/her partner. The partner will then present his/her answers for parts c and d, again seeking feedback. Part e has many potential answers and you should make sure you understand your partner's reason.

Control Class Instructions:

You will have 10 minutes to complete the following question on your own. When time is called, we will review the exercise.

The United States has the following production possibilities associated with computers and SUVs (sport utility vehicles).

| Production Possibility | Computers (thousands) | SUVs |
|---|---|---|
| A | 0 | 300 |
| B | 25 | 280 |
| C | 50 | 240 |
| D | 75 | 180 |
| E | 100 | 100 |
| F | 125 | 0 |

a. Using the information provided above, sketch the production possibilities frontier for the United States.
b. Explain the shape of the production possibilities frontier. Use economic terms and the context of the problem. Some calculations are necessary for your answer to be complete.
c. Suppose that the United States is producing 40 computers and 200 SUVs. In the context of the problem, explain how the United States might find itself at this point.
d. In the context of the problem, explain two ways that economic growth might occur in the United States. How would economic growth be illustrated in your diagram?
e. Assume the United States trades with Mexico, and that the United States has a comparative advantage in the production of computers. Why might they not wish to fully specialize in the production of computers? Explain 1 reason in the context of the problem.

Table 1: Variable Definitions

| Variable | Definition |
|---|---|
| Male | =1 if male |
| Age | = Age in years (current year-year born) |
| Minority | =1 if race/ethnicity is not Caucasian |
| (SAT standardized score)/100 | = (standardized SAT, or converted ACT, combined math and verbal scores)/100 |
| Number of homework completed in a group | Number of homework assignments (0-6) student completed in a group |
| Repeating course | =1 if student is repeating the course |
| High school economics | =1 if the student took economics in high school |
| Business major | =1 if the student expressed intent to major in business |
| Absences | = number of absences during semester |
| Course load | = number of course hours enrolled at start of semester |
| Cooperative learning (CL) | =1 if in treatment, cooperative learning class |
| Large enrollment class | =1 if large enrollment class |
| Course score | Numerical end of course score (percentage of points earned) |
| Pre-TUCE | Number of correctly answered questions on Micro version of TUCE administered on first day of class (33 questions) |
| Post-TUCE | Number of correctly answered questions on Micro version of TUCE administered on last day of class (33 questions) |
| TUCE Gap-closing measure | (Post-TUCE – Pre-TUCE) / (33- Pre-TUCE) |

Table 2a: Descriptive Statistics, Full Sample

| | Full Sample | | |
|---|---|---|---|
| Variables | N | Mean | (SD) |
| Male | 315 | 0.64 | - |
| Age | 315 | 19.68 | (0.92) |
| Minority | 315 | 0.30 | - |
| (SAT standardized score)/100 | 315 | 11.80 | (1.32) |
| Number of homework completed in a group | 315 | 2.74 | (2.56) |
| Repeating course | 315 | 0.08 | - |
| High school economics | 315 | 0.81 | - |
| Business major | 315 | 0.93 | - |
| Absences | 315 | 2.10 | (3.40) |
| Course load (current hours) | 315 | 15.27 | (1.77) |
| Course score | 315 | 70.75 | (17.16) |
| Pre-TUCE | 314 | 11.12 | (3.42) |
| Post-TUCE | 294 | 17.70 | (4.94) |
| TUCE Gap-closing measure | 293 | 0.29 | (0.21) |
| Proportion of sample in large enrollment section | 315 | 0.69 | - |
| Proportion of sample in CL (treatment) section | 315 | 0.61 | - |

Table 2b: Descriptive Statistics, Large and Small Enrollment

| | Large Enrollment | | | Small Enrollment | | |
|---|---|---|---|---|---|---|
| Variables | N | Mean | SD | N | Mean | SD |
| Male | 216 | 0.67 | - | 99 | 0.59 | - |
| Age | 216 | 19.46† | (0.79) | 99 | 20.15 | (1.01) |
| Minority | 216 | 0.30 | - | 99 | 0.31 | - |
| (SAT standardized score)/100 | 216 | 11.78 | (1.38) | 99 | 11.84 | (1.20) |
| Number of homework completed in a group | 216 | 3.25† | (2.53) | 99 | 1.62 | (2.24) |
| Repeating course | 216 | 0.03† | - | 99 | 0.18 | - |
| High school economics | 216 | 0.79 | - | 99 | 0.85 | - |
| Business major | 216 | 0.92 | - | 99 | 0.96 | - |
| Absences | 216 | 2.08 | (3.40) | 99 | 2.14 | (3.42) |
| Course load (current hours) | 216 | 15.34 | (1.88) | 99 | 15.10 | (1.52) |
| Course score | 216 | 69.90 | (17.49) | 99 | 72.59 | (16.36) |
| Pre-TUCE | 216 | 10.94 | (3.10) | 98 | 11.51 | (4.03) |
| Post-TUCE | 200 | 17.48 | (4.86) | 94 | 18.17 | (5.10) |
| TUCE Gap-closing measure | 200 | 0.29 | (0.19) | 93 | 0.29 | (0.23) |
| Proportion in CL (treatment) section | 216 | 0.60 | - | 99 | 0.64 | - |

Note: †Means are statistically different at the 5% significance level.

Table 2c: Descriptive Statistics, Cooperative Learning and Independent Problem Solving

| | Cooperative Learning | | | Independent Problem-Solving | | |
|---|---|---|---|---|---|---|
| Variables | N | Mean | (SD) | N | Mean | (SD) |
| Male | 193 | 0.59† | - | 122 | 0.74 | - |
| Age | 193 | 19.75 | (1.00) | 122 | 19.57 | (0.77) |
| Minority | 193 | 0.28 | - | 122 | 0.34 | - |
| (SAT standardized score)/100 | 193 | 11.77 | (1.48) | 122 | 11.84 | (1.04) |
| Number of homework completed in a group | 193 | 2.53 | (2.55) | 122 | 3.06 | (2.54) |
| Repeating course | 193 | 0.08 | - | 122 | 0.08 | - |
| High school economics | 193 | 0.77† | - | 122 | 0.88 | - |
| Business major | 193 | 0.93 | - | 122 | 0.93 | - |
| Absences | 193 | 2.38 | (3.92) | 122 | 1.66 | (2.31) |
| Course load (current hours) | 193 | 15.25 | (1.85) | 122 | 15.29 | (1.65) |
| Course score | 193 | 70.05 | (18.24) | 122 | 71.84 | (15.32) |
| Pre-TUCE | 192 | 11.02 | (3.55) | 122 | 11.27 | (3.23) |
| Post-TUCE | 179 | 17.68 | (5.25) | 115 | 17.72 | (4.44) |
| TUCE Gap-closing measure | 178 | 0.30 | (0.21) | 115 | 0.29 | (0.20) |
| Proportion in large enrollment section | 193 | 0.67 | - | 122 | 0.70 | - |

Note: †Means are statistically different at the 5% significance level.

Table 2d: Descriptive Statistics, Cooperative Learning and Independent Problem Solving for Large Enrollment Only

| | Large Enrollment with Cooperative Learning | | | Large Enrollment with Independent Problem-Solving | | |
|---|---|---|---|---|---|---|
| | N | Mean | SD | N | Mean | SD |
| Male | 130 | 0.62† | - | 86 | 0.76 | - |
| Age | 130 | 19.54 | (0.86) | 86 | 19.34 | (0.64) |
| Minority | 130 | 0.28 | - | 86 | 0.33 | - |
| (SAT standardized score)/100 | 130 | 11.75 | (1.55) | 86 | 11.82 | (1.08) |
| Number of homework completed in a group | 130 | 2.93† | (2.57) | 86 | 3.73 | (2.40) |
| Repeating course | 130 | 0.04 | - | 86 | 0.02 | - |
| High school economics | 130 | 0.74† | - | 86 | 0.87 | - |
| Business major | 130 | 0.92 | - | 86 | 0.93 | - |
| Absences | 130 | 2.43 | (3.96) | 86 | 1.55 | (2.22) |
| Course load (current hours) | 130 | 15.26 | (1.96) | 86 | 15.47 | (1.75) |
| Course score | 130 | 69.72 | (18.62) | 86 | 70.17 | (15.73) |
| Pre-TUCE | 130 | 10.88 | (3.28) | 86 | 11.02 | (2.83) |
| Post-TUCE | 120 | 17.26 | (5.10) | 80 | 17.80 | (4.50) |
| TUCE Gap-closing measure | 120 | 0.29 | (0.20) | 80 | 0.31 | (0.18) |

Note: †Means are statistically different at the 5% significance level.

Table 3: TUCE Gap-closing measure

| Variable | |
|---|---|
| Large enrollment class | 0.022 |
| | (0.042) |
| Cooperative learning (CL) | 0.059 |
| | (0.046) |
| CL x Large enrollment | -0.074 |
| | (0.053) |
| Male | 0.018 |
| | (0.025) |
| Age | 0.002 |
| | (0.014) |
| Minority | -0.017 |
| | (0.026) |
| (SAT standardized score)/100 | 0.042** |
| | (0.014) |
| Repeating course | -0.159** |
| | (0.053) |
| High school economics | -0.017 |
| | (0.031) |
| Business major | -0.054 |
| | (0.046) |
| Absences | -0.013* |
| | (0.006) |
| Course load (current hours) | -0.008 |
| | (0.006) |
| Constant | -0.047 |
| | (0.368) |
| | |
| Observations | 293 |
| Adjusted R-squared | 0.148 |

Note: Robust standard errors are given in parentheses:
* significant at 5%; ** significant at 1%

Table 4: Course Score

| Variable | |
|---|---|
| Large enrollment class | -6.053** |
| | (2.334) |
| Cooperative learning (CL) | -3.389 |
| | (2.208) |
| CL x Large enrollment | 5.789* |
| | (2.786) |
| Male | 1.635 |
| | (1.381) |
| Age | 0.321 |
| | (0.848) |
| Minority | -4.097* |
| | (1.599) |
| (SAT standardized score)/100 | 3.903** |
| | (1.223) |
| Repeating course | 0.773 |
| | (2.396) |
| High school economics | -0.829 |
| | (1.813) |
| Business major | -0.040 |
| | (3.045) |
| Absences | -3.233** |
| | (0.186) |
| Course load (current hours) | -0.574 |
| | (0.412) |
| Constant | 38.595 |
| | (27.782) |
| | |
| Observations | 315 |
| Adjusted R-squared | 0.540 |

Note: Robust standard errors are given in parentheses:
* significant at 5%; ** significant at 1%

Table 5a: Non-Achievement Outcomes for Sections Engaged in Independent Problem Solving

| | Large Enrollment Sections | | | Small Enrollment Sections | | |
|---|---|---|---|---|---|---|
| | N | Mean | (SD) | N | Mean | (SD) |
| Course satisfaction rating | 76 | 4.53† | 2.79 | 32 | 6.41 | 2.23 |
| Student perceptions of interaction: (Scale: great deal=10; not at all=1) | | | | | | |
| Level of interaction with classmates in course | 76 | 5.72† | 2.42 | 32 | 3.31 | 2.02 |
| Level of interaction with professor in course | 76 | 2.47† | 2.12 | 32 | 3.84 | 2.48 |
| (Scale: less than other classes=1, same=2, more=3) | | | | | | |
| Level of interaction with classmates in this course as compared to student's other courses | 74 | 2.05† | 0.77 | 32 | 1.50 | 0.62 |
| Student evaluations: (strongly agree=5; agree=4; neither agree nor disagree=3; disagree=2; strongly disagree=1) | | | | | | |
| Instructor stimulated my interest in this subject | 76 | 2.79† | 1.29 | 32 | 3.50 | 1.11 |
| Instructor stimulated my thinking | 76 | 3.21† | 1.17 | 32 | 3.75 | 0.84 |
| I learned a great deal from course from this course | 76 | 3.34† | 1.17 | 32 | 3.94 | 0.95 |
| In-class exercises contributed to my learning | 76 | 3.64 | 1.22 | 32 | 4.06 | 0.91 |
| In-class exercises contributed to my satisfaction | 76 | 3.16† | 1.28 | 32 | 3.66 | 0.83 |
| Most and least valuable class assignments/activities | | | | | | |
| Proportion of class naming in-class exercises as most valuable activity | 76 | 0.50 | - | 34 | 0.50 | - |
| Proportion of class naming in-class exercises as least valuable activity | 72 | 0.14 | - | 32 | 0.06 | - |
| Changes in student reported contact, acquaintances, friends | | | | | | |
| Change in the number of classmates with whom a student had had contact over the semester | 40 | 4.75† | 6.35 | 22 | 1.80 | 1.65 |
| Change in the number of classmates with whom a student counted as acquaintances over the semester | 50 | 4.73† | 7.32 | 26 | 1.83 | 1.32 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Change in the number of classmates with whom a student counted as friends over the semester | 54 | 2.69† | 3.00 | 27 | 1.04 | 1.32 |
| Change in likelihood of taking other economics courses aside from macro principles (difference between start and end of term) | 77 | -0.84† | 1.05 | 35 | -0.06 | 1.00 |
| Change in interest in economics (difference between start and end of term) | 77 | -0.81† | 1.13 | 35 | 0.14 | 0.85 |

Note: †Means are statistically different at the 5% significance level.

Table 5b: Non-Achievement Outcomes, for Sections Participating in Cooperative Learning Exercises

| | Large Enrollment Sections | | | Small Enrollment Sections | | |
|---|---|---|---|---|---|---|
| | N | Mean | (SD) | N | Mean | (SD) |
| Course satisfaction rating | 112 | 5.15 | 2.53 | 56 | 5.28 | 2.72 |
| Student perceptions of interaction: (Scale: great deal=10; not at all=1) | | | | | | |
| Level of interaction with classmates in course | 111 | 5.40 | 2.53 | 55 | 4.78 | 2.48 |
| Level of interaction with professor in course | 112 | 2.60† | 1.90 | 56 | 3.76 | 2.20 |
| (Scale: less than other classes=1, same=2, more=3) | | | | | | |
| Level of interaction with classmates in this course as compared to student's other courses | 110 | 1.89 | 0.72 | 56 | 1.84 | 0.76 |
| Student evaluations: (strongly agree=5; agree=4; neither agree nor disagree=3; disagree=2; strongly disagree=1) | | | | | | |
| Instructor stimulated my interest in this subject | 112 | 3.01 | 1.24 | 56 | 3.28 | 1.26 |
| Instructor stimulated my thinking | 112 | 3.36 | 1.10 | 56 | 3.61 | 1.15 |
| I learned a great deal from course from this course | 112 | 3.62 | 1.02 | 56 | 3.66 | 1.23 |
| In-class exercises contributed to my learning | 111 | 3.85 | 1.15 | 56 | 4.07 | 1.08 |
| In-class exercises contributed to my satisfaction | 111 | 3.43 | 1.25 | 56 | 3.27 | 1.21 |
| Most and least valuable class assignments/activities | | | | | | |
| Proportion of class naming in-class exercises as most valuable activity | 115 | 0.50 | - | 54 | 0.65 | - |
| Proportion of class naming in-class exercises as least valuable activity | 108 | 0.10 | - | 51 | 0.08 | - |
| Changes in student reported contact, acquaintances, friends | | | | | | |
| Change in the number of classmates with whom a student had had contact over the semester | 65 | 3.42 | 3.51 | 51 | 3.08 | 3.20 |
| Change in the number of classmates with whom a student counted as acquaintances over the semester | 81 | 2.99 | 3.33 | 42 | 2.89 | 4.80 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Change in the number of classmates with whom a student counted as friends over the semester | 82 | 1.69 | 1.71 | 53 | 1.27 | 1.61 |
| Change in likelihood of taking other economics courses aside from macro principles (difference between start and end of term) | 118 | -0.34 | 1.48 | 57 | -0.30 | 1.09 |
| Change in interest in economics (difference between start and end of term) | 117 | -0.22 | 1.18 | 56 | -0.29 | 0.93 |

Note: †Means are statistically different at the 5% significance level.