Original Research

Do Cooperative-Based Learning Groups Help Students Learn Microeconomics?

SAGE Open
July-September 2020: 1–7

DOI: 10.1177/2158244020938699
journals.sagepub.com/home/sgo
SAGE

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Abstract

As many college students voluntarily form cooperative-based learning groups to study course materials, this article investigates whether or not such type of learning improves their academic performance. This is the first research using Taiwan's higher education data to study cooperative learning in the field of economic education. The data used herein are from 10 intermediate microeconomics courses from 2006 to 2016 at a public university in Taiwan. The sample size is 1,389, which encompasses 120 to 150 enrolled students in each semester. We use an instrumental variables (IVs) approach to remedy the potential endogeneity problem associated with forming cooperative-based learning groups, and the key IV employed is the number of students with the same academic major. The IV estimation results show that forming cooperative-based learning groups does significantly improve college students' learning outcomes. In addition, the cooperative learning effect is heterogeneous across groups. Students with poor attendance records benefit more from voluntarily formed cooperative learning groups in learning microeconomics. Moreover, it is worth noting that the magnitude of the cooperative learning effect from our analysis is greater than the typical class attendance effect.

Keywords

cooperative learning, instrumental variables, microeconomics

Introduction

In addition to competitive learning and individualistic learning, cooperative learning has recently received increasing attention in many disciplines of higher education (Azizan et al., 2018; Foldnes, 2016; Tadessea et al., 2020; Warfa, 2016; Yusuf et al., 2019). According to Johnson et al. (2008), there are three forms of cooperative learning including formal cooperative learning, informal cooperative learning, and cooperative-based groups. Formal or well-constructed cooperative learning exercises refer to students working together for a period of time in a class to solve problems or to complete an assigned joint project. As for informal cooperative learning, students work together in temporary groups for a rather short period of time during a lecture to achieve a common goal. The widely used think–pair–share exercise falls into the informal cooperative learning category. In contrast, cooperative-based groups are long-term heterogeneous groups of students working together for the duration of a course to support each other to complete a joint task or to prepare for exams.

Compared with competitive or individualistic learning, cooperative learning has been regarded as more beneficial and would produce better learning outcomes. Johnson et al. (1998) discussed a variety of theoretical roots of cooperative learning including social interdependence, cognitive–developmental, and behavioral learning models. According to the social interdependence theory, cooperation is a result of positive interdependence among individuals. Through mutual help, exchanging ideas and resources, students can achieve a common goal with collective efforts. From the angle of cognitive science, cooperative learning reinforces the channels through which information and knowledge are transmitted, and thus promotes cognitive growth. The behavioral learning theory supports the argument that individuals choose to collaborate with each other to accomplish a task in face of external rewards associated with the task. These theories all predict that cooperative learning could enhance students' achievement.

Lecture-based instruction has long been the predominant teaching pedagogy in the field of economics; yet, relatively few instructors in the economics discipline devote their lecture time on small group discussion or cooperative learning activities (Watts & Schaur, 2011). Even so, some economists have applied cooperative learning strategies and demonstrated that cooperative learning benefits students when

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learning economics. Using teaching the labor supply curve as an example, Maier and Keenan (1994) found that a simple cooperative learning exercise such as a think–pair–share activity changes the classroom dynamics and benefits students in learning important economic concepts. Marburger (2005) compared students' learning outcomes in the traditional lecture group and cooperative learning group, and noted that students enrolled in a cooperative learning class exhibit better academic performance. Yamarik (2007) designed a two-group experiment and explored the effect of small group learning on students' academic performance. Similar to findings in other disciplines, the author found that cooperative learning enhances students' academic performance. Using a quasi-experimental research design, Emerson et al. (2015) and Emerson et al. (2018) fail to find a significant effect of cooperative learning. However, both Emerson et al. (2017) and Emerson et al. (2018) investigated the effect of applying active cooperative learning activities in large enrollment microeconomic principles courses, showing a positive cooperative learning effect in terms of student-reported satisfaction. In addition, this beneficial effect mitigates the inefficiency costs associated with large enrollment courses.

The main purpose of this study is to examine whether or not forming voluntary cooperative-based learning groups benefits students in learning economics. Students voluntarily set up or joined a cooperative learning group and studied with their classmates to prepare for exams during the semester. Such voluntary cooperative-based groups may be different from formal and informal cooperative learning due to the voluntary nature and lack of shared group accountability. However, voluntary cooperative-based groups preserve the key elements of cooperative learning such as positive interdependence, equal participation, and simultaneous interaction and individual accountability (McGoldrick et al., 2010). It is, therefore, of great importance to better understand the effect of voluntary cooperative learning group when promoting cooperative learning and assessing its effectiveness in higher education. In addition, this is the first research using Taiwan's higher education data to study cooperative learning in the field of economic education. The empirical results and policy implications generated from this research not only help us better understand the cooperative learning effect in economic education but also add value to literature in this line of research.

Data and Statistical Model

The main purpose of this article is to study whether or not forming cooperative learning groups helps college students learn intermediate microeconomics. To conduct this study, we collected students' data from 10 semesters (academic years 2006–2012 and 2014–2016). In each semester, around 120 to 150 students enrolled in the intermediate microeconomics course, with most of them sophomores majoring in economics, public finance, and banking. The sample course was taught by the same instructor using identical course materials during the entire sample period. The final sample size is 1,389.

In this analysis, the major dependent variable is a student's academic achievement measured by course grade ranking in the intermediate microeconomics course. To be able to compare students' course grades across different semesters, every student's intermediate microeconomics course grade is converted to a percentile. The key independent variable is whether or not a student is in a cooperative learning group. In each semester, students need to take three exams when enrolled in the sample course. In each exam, every student was asked whether or not he or she studied this subject with other classmates. If a student answered yes on any of the exams, then he or she was regarded as being in a voluntarily cooperative learning group. We expect that students benefit from voluntarily cooperative learning and would produce better learning outcomes in terms of course grade ranking.

When assessing the effect of being in a voluntarily cooperative learning group on exam performance, it is very likely for endogeneity bias to arise. For instance, students with strong learning motivation are more likely to form a cooperative learning group. These students may also spend more time on studying and, therefore, perform better in exams. As a consequence, a positive relationship between being in a cooperative learning group and one's exam performance could be a result of unobserved motivation. However, it could also be the case that students with lower ability may be the ones seeking for peers' help more often and they are more likely to form a cooperative learning group. In such an instance, we would otherwise observe a negative correlation between being in a cooperative learning group and one's exam performance. To remedy the above potential endogeneity problem, an instrumental variables (IVs) approach is employed to address the issue.

A good IV needs to be highly correlated with the independent variable of interest, but cannot correlate with the random disturbance term. In Taiwan, students with the same major and entering a university in the same year typically become quite close to each other. We expect that students are more likely to form voluntarily cooperative learning groups if there are more peers with the same academic background in the same class. The number of students with the same major is also less likely to be correlated with the random disturbance term in the regression equation. Hence, we collected data on numbers of students with the same major and same year in a class and use this variable as the IV.

Other control variables used in the regression models are male, percentage of classes attended, submit all problem sets, grade point average (GPA), calculus grade, and year dummy. Among these variables, two variables including percentage of classes attended and submit all problem sets are used to capture a student's motivation to some extent. The

variable percentage of classes attended ranges from 0 to 1. It is defined as the ratio of classes attended to total classes for a student within the sample semester. As for the dummy variable, submit all problem sets, it is equal to 1 if a student submits all problem sets and equal to 0 otherwise. We expect that highly motivated students are less likely to miss lectures and tend to submit problem sets on time. Another two variables, GPA and calculus grade, are used to partially control for a student's ability. Both variables are measured on a 100-point scale. Students with higher academic ability probably have higher GPA and perform better in calculus. Lastly, we take into account gender and year effect in our empirical models.

Table 1 lists the summary statistics of all variables used for this analysis. Close to 60% of students are in a cooperative learning group in our sample. We observe that students in a cooperative-based learning group have higher course grade ranking than those not in a cooperative-based learning group. Furthermore, students in a cooperative-based learning group have more peers with the same academic background, attend more lectures, have higher prior GPA, and have higher calculus grade. The findings also indicate that male students are less likely to be in a cooperative-based learning group.

On average, a student in the intermediate microeconomics has around 31 students with the same major. Table 2 presents the distribution of the number of students with the same major in fall 2016. For that semester, the majority of students majored in economics, public finance, and banking. For instance, among 153 enrollees, 50 sophomores majored in economics, 36 sophomores majored in public finance, 17 juniors majored in public finance, and 14 sophomores majored in banking. On average, a student taking the intermediate microeconomics course attended 82% of lectures during the semester, whereas more than 60% of students submitted all problem sets. The number of problem sets required in the sample period ranges from 6 to 9. The instructor assigns certain credits to students if they submit problem sets. Of the students enrolled in the intermediate microeconomics course, 43% are males. The mean score of students' prior GPA is 80.86, and the mean score of students' calculus grade is 81.27. Students' GPA and calculus grade are proxies for their academic ability.

We construct the following regression equation to explore the relationship between a student's intermediate microeconomics course grade ranking and whether a student is in a cooperative-based learning group.

$$y_i = \eta c_i + \beta x_i + \varepsilon_i, i = 1, 2, \ldots, N \quad (1)$$

In Equation 1, y_i is student i's course grade ranking, c_i is whether student i is in a cooperative learning group, x_i is the vector of control variables such as class attendance, problem set submission, gender, GPA, calculus grade, and year dummy variables. ε_i is the random disturbance. As mentioned above, c_i is student i's endogenous choice, which might correlate with the random disturbance ε_i. For example, unobserved factors such as motivation and ability might affect students' decision to form or join a cooperative-based learning group. In such an instance, the key estimate of interest η might be inconsistent under the ordinary least squares (OLS) estimation.

To fix the potential endogeneity problem, we adopt an IV approach. The IV used in this analysis is "Number of Students with the Same Major and Year." As discussed above, this IV is highly correlated to whether or not students form cooperative learning groups, but less likely to be correlated to the random disturbance ε_i, which is the unobservable part of students' semester grade ranking.

Estimation Result

Table 3 reports the OLS results, and Table 4 reports the IV estimation results. The first column in Table 3 presents the full sample OLS results. We find that being in a cooperative-based learning group significantly enhances students' course grade ranking, and that the attendance effect is also significant and positive. This positive result is in line with estimation results in most literature. Students who submit all problem sets are found to have higher course grade rankings as expected. Students with higher prior GPA and calculus grade also score higher in exams.

We later conduct tests of endogeneity to see whether we need to remedy the endogeneity problem associated with the variable of being in a cooperative learning group. Both the robust score chi-square value and robust regression F value reject the null hypothesis that forming a cooperative learning group is exogenous at the 1% level. Details of both tests can be found in Wooldridge (1995) and Hausman (1978). The endogeneity test results demonstrate that the key independent variable is endogenous, which justifies our use of IV in this study. In addition, we conduct the weak IV test to examine whether the IV chosen is appropriate. The first-stage OLS F value is 28.66 and greater than 10, further indicating that we might not need to worry too much about the weak IV issue. It is worth noting that the estimated coefficients are all positive for those control variables representing individuals' motivation and ability, that is, percentage of classes attended, submit all problem sets, GPA, and calculus grade, in the first-stage regression. This implies that students with strong motivation and higher ability are more likely to join cooperative learning group voluntarily.

After employing the IV approach, we find that the magnitude of the cooperative-based learning effect is much greater than that in the OLS approach, which we observe in the first column of Table 4. The estimation result comes with a caveat that the IV approach might not fully solve the endogeneity problem. Highly motivated and/or high-ability students may be those who are more likely to form cooperative learning groups, and these students usually perform better in exams. In such an instance, the estimated cooperative learning effect

Table 1. Summary Statistics.

Variables	Number of observations	*M*	*SD*	Minimum	Maximum
All samples					
Course grade ranking	1,389	50.36	28.88	0.654	100.0
In a cooperative learning group	1,389	0.599	0.490	0.000	1.000
Number of students with the same major and year	1,389	31.05	26.04	1.000	65.00
Percentage of classes attended	1,389	0.818	0.218	0.000	1.000
Submit all problem sets	1,389	0.617	0.486	0.000	1.000
Male	1,389	0.430	0.495	0.000	1.000
GPA (100-point scale)	1,389	80.86	5.994	50.00	95.00
Calculus grade (100-point scale)	1,389	81.27	10.72	0.000	100.0
In a cooperative learning group = 1					
Course grade ranking	832	53.65	27.88	1.307	100.0
In a cooperative learning group	832	1.000	0.000	1.000	1.000
Number of students with the same major and year	832	35.70	25.23	1.000	65.00
Percentage of classes attended	832	0.853	0.186	0.077	1.000
Submit all problem sets	832	0.683	0.466	0.000	1.000
Male	832	0.401	0.490	0.000	1.000
GPA (100-point scale)	832	81.36	5.723	60.00	94.00
Calculus grade (100-point scale)	832	82.14	10.46	8.000	100.0
In a cooperative learning group = 0					
Course grade ranking	557	45.45	29.66	0.654	100.0
In a cooperative learning group	557	0.000	0.000	0.000	0.000
Number of students with the same major and year	557	24.09	25.71	1.000	65.00
Percentage of classes attended	557	0.765	0.250	0.000	1.000
Submit all problem sets	557	0.519	0.500	0.000	1.000
Male	557	0.472	0.500	0.000	1.000
GPA (100-point scale)	557	80.11	6.309	50.00	95.00
Calculus grade (100-point scale)	557	79.96	10.98	0.000	100.0

Note. GPA = grade point average.

from the IV model should be smaller than the one from the OLS model. However, it is not the case here. One plausible explanation is that the current IV might not work well. A better search of potential IVs or other experimental approaches might be a solution to better estimate the cooperative learning effect for future research.

In this analysis, the attendance effect is statistically significant, but smaller than that in the OLS model. Similar to the results in the OLS model, students who submit all problem sets and students with higher prior GPA and calculus grade perform better on intermediate microeconomics. Males relative to their female counterparts have better learning outcomes in the IV model. However, the gender variable is not statistically significant in the OLS model.

In light of the fact that the attendance variable might as well be endogenous, we next investigate whether the cooperative-based learning effect is different across various groups by students' attendance status. In these three groups, 730 students attended more than 90% of lectures, 659 students attended 50% to 90% of lectures, and 138 students attended less than 50% of lectures. After controlling for other covariates and year dummy variables, we reject the null hypothesis that forming a cooperative learning group is exogenous. The cooperative learning effect is decreasing when attendance rate increases. The cooperative learning effect is found to be greater for students with a worse attendance record, but lower for students with a rather good attendance record. This implies that students with weaker motivation would benefit much more than their highly motivated counterparts from voluntarily formed cooperative group. We also find a significant and positive attendance effect in the full sample. This finding is consistent with that in previous literature (Chen & Lin, 2008). Furthermore, submitting all problem sets and having a higher prior GPA produce significant and positive effects on learning outcomes.

Conclusion

This study contributes to the growing literature exploring the effect of cooperative learning in learning economics. In particular, we investigate whether or not voluntarily forming cooperative-based learning groups benefits students when they are studying intermediate microeconomics. We collected data from 10 semesters and used this rich data set to

Table 2. Distribution of Number of Students With the Same Major and Year (Fall 2016).

Major	Year	Number of students
Economics	Sophomore	50
Public finance	Sophomore	19
Public finance	Junior	17
Banking	Sophomore	14
Economics	Junior	6
Chinese literature	Senior	4
Diplomacy	Junior	4
Statistics	Sophomore	4
History	Senior	3
Diplomacy	Senior	2
Political science	Senior	2
Accounting	Junior	2
Ethnology	Senior	2
Statistics	Junior	2
Statistics	Senior	2
Economics	Senior	2
Management information system	Sophomore	2
Risk management and insurance	Junior	2
Philosophy	Sophomore	1
Philosophy	Senior	1
Land economics	Junior	1
Political science	Junior	1
Accounting	Sophomore	1
German	Junior	1
German	Sophomore	1
Spanish	Senior	1
Ethnology	Junior	1
Sociology	Senior	1
English	Junior	1
Finance	Sophomore	1
Arabic	Junior	1
Korean	Senior	1

explore the voluntarily cooperative-based learning groups' effect. We find that many students voluntarily form cooperative learning–based groups when they took the intermediate microeconomics course. More than 60% of students in our sample have studied with their classmates to prepare for exams during the duration of the course.

Using Taiwan's higher education data, our empirical evidence shows that students benefit from voluntarily formed cooperative-based learning groups when they learn microeconomics. After considering the potential endogeneity bias, our IV estimates support a positive cooperative-based learning group effect. Students in a voluntarily cooperative-based learning group perform better in exams and have a higher course grade ranking. We also observe a heterogeneous cooperative learning effect among students with different attendance records. The cooperative learning effect is greater especially for those with poor attendance records. Less motivated students would benefit more than their highly motivated counterparts from voluntarily formed cooperative learning group. The positive cooperative learning effect conforms to conclusions reached in prior literature. Students work with their group members and gain from participating in a variety of learning activities such as discussion, coaching, and scaffolding. Hence, being in a voluntarily formed cooperative learning group produces better learning outcomes.

Teaching economics in higher education has become more and more challenging. Many teachers have adopted various ways of instruction to enhance students' learning. In light of the above findings, informing students about the benefits of cooperative learning and implementing policies to encourage students to form study groups could enhance their learning of intermediate microeconomics and produce better academic outcomes. Moreover, in addition to the cooperative-based learning group approach, the instructor could consider experimenting with well-constructed cooperative learning activities to aid students in learning economics.

Lastly, it is of note that, in addition to the IV method used in this analysis, experimental approaches could be employed to

Table 3. The Determinants of Course Grade Ranking (OLS Results).

Variables	All sample	Percentage of classes attended (above 90%)	Percentage of classes attended (between 90% and 50%)	Percentage of classes attended (below 50%)
In a cooperative learning group	2.599*	−1.210	6.009***	8.630**
	(1.362)	(1.896)	(1.904)	(4.214)
Percentage of classes attended	16.67***	47.91*	18.37***	25.31
	(3.706)	(24.78)	(4.883)	(15.77)
Submit all problem sets	11.26***	8.793***	13.15***	7.871
	(1.650)	(2.526)	(2.206)	(5.680)
Male	1.961	2.405	0.986	2.128
	(1.310)	(1.814)	(1.889)	(3.858)
GPA (100-point scale)	1.402***	1.875***	0.982***	0.835**
	(0.149)	(0.218)	(0.192)	(0.327)
Calculus grade (100-point scale)	0.493***	0.655***	0.430***	0.107
	(0.0857)	(0.120)	(0.103)	(0.205)
Constant	−124.1***	−202.6***	−89.35***	−55.12**
	(9.178)	(25.14)	(12.83)	(21.71)
Year dummy	Yes	Yes	Yes	Yes
Observations	1,389	730	659	138
R^2	.364	.315	.324	.258

Note. White (1980) robust standard errors are in parentheses. OLS = ordinary least squares; GPA = grade point average.
"***" is significant at .01, "**" is at .05, and "*" is at .1 Type I error levels.

Table 4. The Determinants of Course Grade Ranking (IV Results).

Variables	All sample	Percentage of classes attended (above 90%)	Percentage of classes attended (between 90% and 50%)	Percentage of classes attended (below 50%)
In a cooperative learning group	26.41***	22.08***	24.82***	44.61*
	(6.131)	(8.483)	(8.119)	(26.94)
Percentage of classes attended	8.853**	43.90	12.86**	6.573
	(4.457)	(27.86)	(5.601)	(23.02)
Submit all problem sets	9.660***	7.582***	11.43***	−2.870
	(1.847)	(2.862)	(2.400)	(11.94)
Male	2.736*	3.751*	1.392	4.554
	(1.447)	(2.038)	(1.996)	(4.925)
GPA (100-point scale)	1.458***	1.875***	1.069***	0.608
	(0.167)	(0.245)	(0.207)	(0.472)
Calculus grade (100-point scale)	0.430***	0.613***	0.365***	0.114
	(0.0916)	(0.139)	(0.105)	(0.245)
Constant	−130.2***	−208.8***	−98.19***	−40.19
	(10.18)	(28.20)	(14.02)	(33.14)
Year dummy	Yes	Yes	Yes	Yes
Weak IV				
First-stage OLS R^2	.1237	.0939	.1282	.1739
First-stage OLS *F* value	15.87***	6.01***	7.83***	4.70***
Tests of endogeneity				
Robust score χ^2 value	20.16***	10.15***	6.661***	3.081*
Robust regression *F* value	20.44***	10.28***	6.562***	2.796*
Observations	1,389	730	659	138

Note. White (1980) robust standard errors are in parentheses. IV = instrumental variable; GPA = grade point average; OLS = ordinary least squares.
"***" is significant at .01, "**" is at .05, and "*" is at .1 Type I error levels.

address the endogeneity issue. The fact that students voluntarily formed learning groups in this analysis indicates a potential endogeneity problem. More abled or highly motivated students may be more likely to form cooperative learning groups voluntarily and they usually perform better in exams. Therefore, the positive cooperative learning effect might be a beneficial result of being in cooperative-based groups but could also be a result of the unobserved heterogeneity. To disentangle these unobserved factors from our models and better estimate the cooperative learning effect, randomized experiments or quasi-experiments could be considered in the future.

Acknowledgments

We are grateful to Sudipta Roy and seminar participants at the 2018 Annual American Economic Association (AEA) Conference on Teaching and Research in Economic Education for their thoughtful comments and suggestions. All errors are our own.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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