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Do Peers Affect Undergraduates' Decisions to Switch Majors?

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Abstract

This study used college dormitory room and social group assignment data to investigate the peer effect on the probability of college students switching their major fields of study. The results revealed strong evidence of peer effects on students' decisions to switch majors. In particular, the number of a student's peers who have the same major significantly reduces the student's likelihood of switching majors; however, when a same-major peer switches majors, it significantly increases a student's probability of switching majors. This study also found that peers' majors affected students' choice of destination majors. Students in the same peer group are more likely to choose the same destination majors, compared to non-peers. Finally, we found that in general peer effects at the dormitory room level, both in choice and persistence of major, were stronger than were peer effects at the social group level.

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1. Introduction

Researchers have long been interested in college students' choice of major and the extent to which they persist in their majors. College majors play an important role in defining students' college experience. The major field of study, to varying degrees, determines the courses that students take, the faculty members with whom students connect, the peers with whom students interact within and outside classes, and the departmental cultures to which they are assimilated (Pascarella, Terenzini, & Feldman, 2005). Furthermore, the important effect of college majors on labor market outcomes can hardly be overstated. Differences in earnings are substantial across majors (Arcidiacono, 2004; Black, Sanders, & Taylor, 2003) and are much larger than differences in other academic factors, such as college selectivity and academic performance (Ma & Savas, 2014; Thomas & Zhang, 2005).

Studies of college-major choices have predominantly focused on individual characteristics and academic experiences. These factors include students' academic performance, self-efficacy in particular majors, gender, race, and family socioeconomic status (Arcidiacono, 2004; Arcidiacono, Hotz, & Kang, 2012; Cohoon, 2001; Davies & Guppy, 1997), as well as students' high school curricula, classroom experiences, and quality of faculty (Bettinger & Long, 2010; Cabrera, Colbeck, & Terenzini, 2001; Elliott, Strenta, & Adair, 1996). Similarly, studies of students' persistence in their majors primarily focus on students' gender, ethnicity, academic preparation in high school (Campbell & McCabe, 1984; Clark Blickenstaff, 2005; Kokkelenberg & Sinha, 2010), as well as academic performance in college, major-interest fit, and faculty characteristics (Allen & Robbins, 2007; Ost, 2010; Price, 2010).

Researchers have rarely examined the effect of peers on students' choice of major and on students' persistence. Examining peer influence on these outcomes is particularly interesting because many attributes that researchers have studied are either non-malleable (e.g., individual characteristics) or require substantial financial and human resources (e.g., high school academic preparation, faculty characteristics). Peers, however, can serve as convenient, unobtrusive, and inexpensive policy instruments. Previous studies have found that peers significantly influence academic performance (Carrell, Fullerton, & West, 2009; Lyle, 2007; Sacerdote, 2001; Zimmerman, 2003) and students' social behaviors, including use of cigarettes and alcohol (Borsari & Carey, 2001; Unger et al., 2002; Urberg, Değirmencioğlu, & Pilgrim, 1997). Inasmuch as peers are an important information source for one another (Head & Eisenberg, 2010; Pimpa, 2003), their knowledge of majors (e.g., the rigor of curriculum, employment prospect, and earnings) might influence their decision to choose or switch to particular majors. Limited research in this area suggests that the peer effect exists. For example, Pascarella and Terenzini (2005) concluded that a student's dominant peer group influenced his or her major field of study at an institution. Cohoon (2001) noted the importance of peer support in computer science students' persistence in their major.

Although these results are inspiring, the conclusions are ambiguous because students self-select into peer groups (e.g., programs, departments, and schools). Therefore, the observed influence of peers and similarity in choice of major and persistence could derive from unobserved similarities among peers in a group. To disentangle selection bias and the peer effect, rigorous empirical methods are essential (Sacerdote, 2014); however, studies of peer effects on choice of major and persistence indicate scant use of experimental or quasi-experimental methods to eliminate selection bias. Two notable exceptions are De Giorgi, Pellizzari, and Redaelli (2010a), who used randomly assigned college classmates and partially overlapped peer groups to identify peer effects on students' choice of majors; and Anelli and Peri (2015), who used the variation in gender composition of high school classes to identify how this composition affected students' choice of majors that reflect predominantly male or female students.

In this study, we examine peer effects on undergraduate college students' decisions to switch majors. We attempt to address two research questions: (a) Do peers' initial major composition and switching behaviors affect students' decision to switch majors? (b) Among those who switched their majors, do their peers' majors influence their choices of new majors? We obtained data from a college in China where students' peers (i.e., roommates and social group mates) are randomly assigned, conditional on two known factors. In addition, we used fixed effects of the peer groups, to account for common shocks during college that might increase the peer group's probability of switching majors. By eliminating selection bias and common shocks, this study provides credible evidence of peer influences on students' switching of majors and on their subsequent choice of major after having dropped out of their initial majors.

2. Related Literature

Both monetary and non-monetary factors drive choices of college majors. Cebula and Lopes (1982) found that expected monetary return for graduates across different majors partly explains choices of major fields of study, a finding echoed by Montmarquette, Cannings, and Mahseredjian (2002). Berger (1988) further argued that students also considered the option value of some majors, which is represented by the probability of and economic benefits from attending graduate school. Among non-monetary factors, academic performance plays an important role both in choice of and persistence in one's major. Arcidiacono (2004) and Davies and Guppy (1997) found that students with high math abilities preferred majors associated with lucrative careers. Allen and Robbins (2007) found that a student's first-year academic performance measured by GPA, especially in one's own subject area, strongly predicted persistence in major. Ost (2010) further suggested that while students in the life and physical science majors were more likely to persist if they had higher GPAs in their own subjects, an increase in GPA in a non-science subject was negatively associated with the student's propensity to persist in the life and physical science majors.

Furthermore, the pattern of major choice and persistence differs by gender, race, and socioeconomic backgrounds. For example, studies have shown that female students were more likely than their male peers to choose education and humanities majors and less likely to choose lucrative fields of study, including science, engineering, and business science majors (Davies & Guppy, 1997; Polachek, 1978). Studies have also shown that female students were less likely than their male peers to persist in science, technology, engineering, and mathematics (STEM) majors (Cohoon, 2001; Dickson, 2010; National Science Board, 2007). Asian men were more likely than their White peers to enter and persist in science and engineering majors, while Black and Hispanic students were less likely than Whites to persist in science and engineering majors (Dickson, 2010). Students from low-socioeconomic families were more likely to enter lucrative majors (Davies & Guppy, 1997).

A few studies have investigated peer effects on major-related choices. Many of these studies used students in the same department or college as the peer group. For example, Astin and Astin (1992) used all students in the freshmen class as a peer group and found that students were more likely to choose a major in science, mathematics, and engineering if many of their peers chose one of these majors. In addition, students were more likely to persist in physical science and engineering when the proportion of their peers majoring in these fields increased.

Cohoon (2001) used other female students in the same department as a peer group for female students. Gender composition at the departmental level was the single most powerful predictor of female attrition in computer science departments. As the number of female students in a computer science department increases, their attrition rate significantly decreases. Griffith (2010) arrived at similar conclusions by using all students in a college as the peer group. The results suggested that a 10% increase in the proportion of female PhD students in STEM fields would increase the persistence rates for female students in the same fields by approximately 6 percentage points. Only in rare cases has research found a student's persistence level to be independent of their peers. For example, Rask (2010) found that in a small liberal arts college, the ratio of female students in an introductory STEM course did not predict a student's probability of persisting into the second STEM course.

Uncovering peer effects in large units such as departments or colleges is not easy because most students do not have meaningful interactions with that many peers. In addition, naturally formed peer groups (i.e., classes, department, and colleges) usually include individuals with unobserved, inherent similarities that could lead to similar outcomes. To disentangle the selection bias and peer effect, Sacerdote (2014) recommended using peer groups formed based on exogenous processes, e.g., random assignment. Only a few studies have applied this strategy to investigate choice of major. For example, De Giorgi et al. (2010) studied peer effects by using undergraduate data from Bocconi University, a private Italian institution that specializes in management and economics. Students were first randomly assigned to different teaching classes on the same topic, and they chose their majors at the end of their third semester. The authors defined student peer groups as randomly assigned classmates who had taken at least four classes together. Their results indicated that a student was more likely to choose a major when many of his or her peers made the same choices. Specifically, a 10% increase in the proportion of peers choosing economics promoted an average student's propensity to choose economics by 13% (De Giorgi et al., 2010).

Lyle (2007) used a similar empirical strategy and obtained data from West Point, where plebes (i.e., freshmen) were randomly assigned to different companies, which contained 35 students in every class. A plebe's peer group thus contained 34 other plebes, 35 sophomores, and 70 upperclassmen in the same company. Lyle found that a plebe's sophomore peers significantly influenced the plebe's likelihood of choosing engineering as a major. Specifically, a 10% increase in the fraction of sophomore peers who intended to study engineering led to a 1.5% increase in a plebe's probability of majoring in engineering. Using housing data from Dartmouth College, Sacerdote (2001) found that peers had significant effects on students' freshman-year GPAs and decisions to join fraternities but did not influence students' decisions about college majors.

We used a similar empirical strategy, whereby we relied on conditionally randomly assigned peers, to identify peer effects on students' decisions to switch majors. We used two peer groups, dormitory roommates and social group mates, with which each student has substantial and meaningful social interactions. We examined peer effects both on their decisions to switch majors and on their final choices of major.

3. Data and Sample

For this study, we collected student-level administrative data from a four-year, regional college in China. The college enrolls mainly resident students from the province in which it is located and approximately 20–25% from other provinces. The data represent the three freshman classes of 2010–2012, not including approximately 200 dropped out students. The overall sample size is 9,771. The three entering cohorts were of similar size. The housing data include 2,431 physical dormitory rooms, 2,384 of which are occupied by students from the same cohort, and the remaining 47 rooms are occupied by students from different cohorts. We operationalize the definition of a room as a social environment in which same-cohort students share a living place. Under this definition, a mixed-cohort physical room is broken down to multiple single-cohort social rooms. As a result, we have 2,478 social dormitory rooms, all of which are occupied by single-cohort students. These include 39 single rooms (which are removed from the analysis due to null peer group size), 17 double rooms, 132 triple rooms, 2,211 quadruple room, and another 79 rooms occupied by five to seven students. In the rest of the paper, we refer to the social rooms as rooms and to same-cohort roommates as roommates. In a separate analysis using only single-cohort rooms (after removing the 47 rooms with students from different cohorts), the results are nearly identical to the findings reported in this paper.

The data collected contained information on students' backgrounds, including ethnicity, high school, resident province, birth date, gender, and college entrance exam score. The administrative data files also contained panel information on students' semester GPAs, credits obtained, dormitory rooms, dormitory buildings, initial and final majors (in which their college degrees were conferred), and dates of changes in majors. All students from the three cohorts entered college immediately after graduating from high school. Ethnic minorities totaled 1.5–3% of students in each cohort.

When students apply for college in China, they need to indicate a major field of study on their applications. This college has 23 majors, although most students chose among a few accounting and finance-related fields of study, with the most popular major being accounting (certificated public accountant concentration). Approximately half of the students in each cohort chose this as their initial major. Table 1 provides the distribution of the college's top 10 majors. The most popular majors had stable enrollment from 2010 to 2012; eight of them were related to accounting or finance. The students enrolled in these majors represented over 90% of all students in their cohorts.

This college has two interesting features that differ from most colleges and universities in China. First, colleges and universities in China generally discourage students from switching majors. This particular college, however, allows students to switch majors without many constraints. In fact, many students take advantage of this opportunity and switch majors during their four years in college. For example, 21.8% of students in the 2010 cohort, 21.6% of students in the 2011 cohort, and 16.5% of students in the 2012 cohort changed their majors before they graduated. This provides a unique opportunity to observe students' major-switching behaviors and potential peer influences on these behaviors.

Another feature of this college is its process for assigning students to dormitory rooms. We conducted extensive interviews with the college's director of residential life to understand the room assignment process. Only three factors determine the assignment of dormitory rooms: gender, mode of matriculation (online or on site), and time of matriculation in the case of on-site matriculation. Male and female students reside in separate dormitory buildings. New students have the option to matriculate online during the summer break or on site right before the beginning of the academic year in the fall. During online matriculation, students can choose one of eight random rooms provided by the system, whereas during on-site matriculation, students are assigned to the next available bed sequenced by room numbers and bed numbers. Students' majors are not considered at all in the room assignment process.

Once roommates are assigned, they share the same room for their entire journey in college; room relocation is extremely rare. After room assignment, the Office of Student Affairs created social groups that consist of some adjacent rooms in male buildings and some adjacent rooms in female buildings. These social groups, which typically include 40 to 60 students, are designed to coordinate students' extracurricular activities. Throughout the academic year, group advisors organize such activities as spring outings, community service, career services, and arts festivals. The associate dean of student affairs in this college told us that "almost all student activities outside classroom are centered around social groups." Given the considerable interaction among roommates and social group members, we use both peer groups to examine their effects on major-switching decisions.

Because room assignments are based on students' choice of online or on-site matriculation and time of matriculation, this creates a process that is not as pristine as a random assignment. After consulting the director of residential life at the college, we discovered two loopholes in the process that could allow students to game the system and choose their roommates and/or social group members. First, because students who registered online were given eight random rooms from which to choose, friends could select the same room (or adjacent rooms) when choices provided by the system overlapped. Second, for those who matriculated on site, the time of matriculation determined the room assignment. Since friends were more likely to go to the matriculation office together, they likely ended up in the same room. When friends shared similar unobserved characteristics, the clustering of similar students in dormitory rooms would ultimately lead to biased estimates.

Because students from the same high school is a good indicator that students knew one another before college, we investigate room assignment further by examining whether students from the same high school were more likely to be in the same room. In the first exercise, we used a Monte Carlo simulation to simulate the number of dormitory rooms housing two or more students from the same high schools, under random assignment. In other words, if the roommate assignment had been truly random (conditional on gender), how many rooms would contain students from the same high schools? The results, shown in Figure 1, suggest that on average, approximately 45 rooms would house multiple students from the same high schools and that 95% of the time, fewer than 57 rooms would house multiple students from the same high school. However, the real data showed 283 such rooms, suggesting the clustering of students from the same high schools within the dormitory rooms.

Consequently, we removed from the data all rooms with students from the same high school, resulting in 8,602 students in 2,156 rooms. Table 2 compares basic statistics between the full and reduced samples. Some differences are noteworthy. First of all, social group size and the number of switched group mates are significantly smaller in the reduced sample. Given that reduced sample is generated by dropping students from the full sample without reducing the total number of social groups, the decreasing of social group average statistics is expected. Secondly, the proportion of students from the resident province is lower in the reduced sample than in the full sample, suggesting that students from the resident province are more likely to have their friends as roommates. Thirdly, Students who matriculated online are more likely than students who matriculated on site to have their friends as roommates. Finally, the average number of same-major roommates in the full sample is higher than in the reduced sample, indicating that friends are more likely to choose the same majors than non-friends are, providing additional justification for the removal of rooms with students from the same high schools.

Table 3 presents an additional random check in which we examined the correlation between students' and their roommates' characteristics. In the full sample, students from the science track in high school were more likely to become roommates. In the reduced sample, none of the students' observable characteristics correlate significantly with those of their peers, after we controlled for registration type, registration sequence, and building fixed effects. Because self-selected peer groups implied unobserved similarities among peers, which almost certainly brought an undesired upward bias to the estimated peer effects, the reduced sample would provide better evidence of peer effects.

4. Methods

We used linear probability models to predict a student's probability of switching their major as a function of the number of same-major peers and the number of peers who switched their majors. In formal terms,

$$\boldsymbol{Y_i = \beta_0 + \beta_1 X_i + \beta_2 M_{-i} + \beta_3 Y_{-i} + \beta_4 Z_i + \varepsilon_i} \qquad (1)$$

The dependent variable, Y_i , is a dummy variable, which equals 1 if a student switches their major before college graduation. X_i is a vector containing the student's characteristics (e.g., race, gender, initial major, and first-year GPA). M_{-i} indicates the number of peers who share the same initial major with student i, because previous studies have concluded that a student is more likely to persist in a major when the student receives support from same-major peers (Cohoon, 2001; Griffith, 2010). β_2 measures the exogenous peer effect. Y_{-i} is the number of peers who switched their majors. The parameter of Y_{-i} measures the size and direction of the endogenous peer effect on students' change of majors. Z_i refers to a vector of controlling variables: (a) whether student i matriculated online, (b) the student's matriculation sequence, and (c) the dormitory building to which the student is assigned. ε_i represents the error terms, which are heterogeneous like all error terms in a linear probability model. To remedy this, we used bootstrap to estimate the standard errors for all linear probability models in this study.

This study focused on peer effects, so the causality of M_{-i} and Y_{-i} in Eq. (1) are of concern. Because the formation of peer groups in this college is conditionally random, M_{-i} is not correlated with unobserved pre-college individual characters. The number of peers who switched their majors, Y_{-i}, was unfortunately endogenous in the model. The endogeneity stemmed from two factors: common shocks and simultaneity. Students in the same peer group might experience some common shocks during college that increase all the group members' probability of switching majors. Omitting the common shock might introduce an upward bias for Y_{-i} in the model. The simultaneity problem can be illustrated best through a simplified case: assuming student i and student j are the only two students in a dormitory room, then Eq. (1) can be re-written in the following form:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 M_j + \beta_3 Y_j + \beta_4 Z_i + \epsilon_i \quad (2)$$

$$Y_j = \beta_0 + \beta_1 X_j + \beta_2 M_i + \beta_3 Y_i + \beta_4 Z_j + \epsilon_j \quad (3)$$

Therefore, Y_i and Y_j are co-determined. Plugging Eq. (3) into Eq. (2) results in the following equation:

$$Y_i = \frac{\beta_0+\beta_0\beta_3}{1-{\beta_3}^2} + \frac{\beta_1 X_i+\beta_1\beta_3 X_j}{1-{\beta_3}^2} + \frac{\beta_2 M_j+\beta_2\beta_3 M_i}{1-{\beta_3}^2} + \frac{\beta_4 Z_i+\beta_3\beta_4 Z_j}{1-{\beta_3}^2} + \frac{\epsilon_i+\beta_3\epsilon_j}{1-{\beta_3}^2} \quad (4)$$

Thus, when $\beta_3 \neq 0$, $E(Y_i\epsilon_j|X, M, Z) = \frac{\beta_3}{1-{\beta_3}^2} E\left({\epsilon_j}^2\right) \neq 0$. Y_i is endogenous in Eq. (3), and similarly Y_j is endogenous in Eq. (2).

The endogeneity problem compromises the credibility of the estimated peer effects from Eq. (1). As Manski (1993) illustrated, when one models a student's outcome by their peers' outcome and background characteristics, a reflection problem arises. Unfortunately, the reflection problem is difficult to solve. Previous studies have used instrumental variables to separate endogenous and exogenous peer effects (e.g., Hanushek, Kain, Markman, & Rivkin, 2003; De Giorgi et al., 2010; Lee, 2007; Bramoulle, Djebbari, & Fortin, 2009). Nevertheless, if the estimated peer effect is sufficiently large, Eq. (1) provides evidence of the direction of the endogenous peer effect. To determine the magnitude of estimates needed to affirm the existence of peer effects, we used a Monte Carlo simulation to investigate the property of $\widehat{\beta_3}$ when β_3 is set to zero. This exercise suggested that when β_3 was set to zero, the 95% confidence interval for its t-statistics was [-2.94, 2.75] at the room level and [-2.89, 2.40] at the group level. In other words, if the t-statistics for the total peer effect in the data are beyond these intervals, then its significance is not entirely driven by simultaneity, i.e., the exogenous peer effect is at least significantly different from zero.

To examine the differential effect of same-major peers by their major-switching behaviors, we extend Eq. (1) to include four mutually exclusive subgroups, each of which is defined by their peers' initial major and switching behavior:

$$Y_i = \beta_0 + \beta_1 X_i + \theta_0 S_{i00} + \theta_1 S_{i01} + \theta_2 S_{i10} + \theta_3 S_{i11} + \beta_2 Z_i + \varepsilon_i \qquad (5)$$

Where S_{i00} represents the number of different-major peers who did not switch majors, S_{i01} is the number of different-major peers who switched majors, S_{i10} stands for same-major peers who did not switch majors, and finally, S_{i11} denotes the number of same-major peers who switched majors.

Peers may influence not only students' decisions to switch majors but also their choice of new majors. In other words, after switching majors, peers may be more likely than a pair of random students to have the same majors. Inspired by Bayer, Ross, and Topa (2008), we used the following model to estimate a pair of students' likelihood of having the same destination major:

$$Pair_{ij}^{l} = \alpha_l + \beta X_{ij} + \theta Z_{ij} + \gamma G_{ij} + \varepsilon_{ij} \qquad (6)$$

where $Pair_{ij}^{l}$ indicates whether a pair of students i and j in the same cohort have the same majors after switching (measured by the major at the time of college graduation). α_l is cohort fixed effects, representing the probability that all students in the same cohort will have the same destination major. X_{ij} represents students i's and j's pair characteristics, e.g., both i and j are female students, and Z_{ij} represents students i's and j's registration type, registration sequence, and building effects. G_{ij} is an indicator equal to 1 if students i and j are from the same peer group. Eq. (6) essentially compares a pair of peers with a random pair of students in the same cohort. If peers affect choice of major, γ would be significantly different from zero.

We used two peer groups: roommates and social group mates. Recall that the assignment of peer groups, either to dormitory rooms or social groups, was conditionally random in the reduced sample. Therefore, G_{ij} is not correlated with any unobserved pair of student characteristics. Note that the unit of analysis here was no longer individual students but pairs of students. To illustrate, consider a social group that includes 10 rooms with four students in each room. Each room forms six (i.e., ${}_4C_2$) student pairs, resulting in a total of 60 within-room pairs. By contrast, this group of 40 students can form 780 (i.e., ${}_{40}C_2$) pairs. In this step of the analysis, the 8,641 students in the reduced sample are transformed into 13,060 pairs of roommates, 186,245 pairs of social group mates, and 12,490,265 pairs of cohort mates. We used OLS with bootstrap to estimate the linear probability model.

5. Results

5.1. Peer effects on switching majors

Table 4 reports the results of Eq. (1), whereby a student's probability of switching majors depended on the number of same-major peers and the number of peers who switched majors. The model also controlled for a host of covariates, including non-residence status, college entrance exam score, high school academic track, ethnicity, gender, dormitory room size, program size, registration information, building fixed effects, and cohort fixed effects. The results associated with these covariates are not reported in the table and are available upon request. We estimated the effect for both roommates and social group mates. The first column uses all students from the 2010–2012 cohorts. The result for roommates suggests that having one additional roommate who shared the same initial major significantly reduced a student's probability of switching majors by 2.10 percentage points. The estimated effects were consistent across the three cohorts. As shown in the next three columns, the effect of having one additional same-major roommate was 2.26, 1.72, and 1.85 percentage points for the 2010, 2011, and 2012 cohorts, respectively. Finally, the peer effect seemed to be stronger for female than for male students: one additional same-major roommate reduced a female student's probability of switching majors by 2.32 percentage points; the reduction was 1.87 percentage points and non-significant for male students.

The results shown in the second row indicate that a student was more likely to switch majors when they had a greater number of peers who switched their majors. Although the simultaneity problem increases the chance of a Type I error (i.e., false positive), the large t-statistics, ranging from 6 to 14.4, suggest that living with a roommate who switched majors likely yielded a significant positive effect on an individual's probability of switching majors. On average, a student's roommate who switched majors increased that student's likelihood of switching majors by 8.51 percentage points; the effect was 9.30, 8.45, and 6.66 percentage points for the 2010, 2011, and 2012 cohorts, respectively. These effects were more than four times the size of the effect of having a same-major roommate. The endogenous peer effect was again stronger for female students (9.28 percentage points) than for male students (6.31 percentage points).

The lower panel in Table 4 reports the results of the social group-level analysis. The estimated peer effects of a social group mate were much smaller than the effects of a roommate, which is not surprising; on average, having a same-major roommate reduced a student's probability of switching majors by 2.10 percentage points, but having a same-major social group mate decreased that chance by only 0.38 percentage points. The size of the peer effect was less stable in the social group-level analysis than in the room-level analysis, probably because of the small overall initial effects. For example, having one male peer who shared the same initial major decreased a male student's likelihood of switching majors by 0.81 percentage points, but having one female peer who shared the same initial major did not significantly impact a female student's chance of switching. The endogenous peer effect at the social group level was also much smaller than that for the room-level analysis: a student's social group mate who switched majors increased that student's probability of switching by only 1.23 percentage points, much smaller than the 8.51 percentage points for roommates. As in the room-level analysis, the endogenous peer effect was consistent across cohort and gender.

Table 5 present the results for Eq. (5), which we used to evaluate the effects of four mutually exclusive peer subgroups. Two observations emerge. First, the influence of same-major peers was far greater than that of different-major peers. In both room-level and social group-level analysis, the effects of same-major peers, whether they switched majors or not, were large and statistically significant, whereas the effects of different-major peers were insignificant in most cases. The only significant effect of different-major peers occurred among social group mates, in which the number of different-major peers who switched their majors was negatively related to the probability of a student's decision to switch majors. The effect, however, was rather small.

Second, peers with the same major tended to make similar decisions. Specifically, the number of a student's same-major peers who switched majors had a large and positive effect on that student's probability of switching majors. The effect was consistent across cohort, gender, and peer-group level. A student's same-major roommate who switched majors increased that student's probability of switching majors by 13.9 to 19.1 percentage points, while a same-major group mate who switched majors increased that probability by 2.87 to 4.19 percentage points. Similarly, the number of a student's same-major peers who remained in their majors had a negative effect on that student's switching of majors, i.e., they were also likely to remain in their initial major. On average, a student's same-major peer who remained in the initial major decreased that student's probability of switching majors by 1.30 percentage points among social group mates and 5.9 percentage points among roommates. This result is consistent with previous studies showing that a student is more likely to persist in a major when the student receives support from same-major peers (Cohoon, 2001; Griffith, 2010).

These results clearly support peer effects in major-switching decisions. Students with more same-major peers were less likely to switch to another major than were students with no such peer support. However, if a student's same-major peers switched majors, they exerted a large peer effect on that student's decision to switch majors. These peer effects existed at both the room and social group levels, although the effect of the former was much larger than that of the latter.

5.2. Peer effects on choices of new majors

To examine students' choice of major after having switched their majors, we used pairs of students instead of individual students as the unit of analysis. In particular, we compared the following three groups: roommates, social group mates, and cohort mates. We expected that if positive peer effects exist, then related to pairs formed among cohort mates, pairs within the same room and within the same social group (but not within the same room) would be more likely to have the same final major. In particular, we expected that the peer effects among roommates would be larger than those among social group mates.

Table 6 reports estimates based on Eq. (6). First, we used the entire reduced sample of students to test whether peers were associated with a higher probability of having the same initial major. Given the college's conditional random assignment of roommates, we expected the association to be null, which the results shown in the first column of Table 6 support. In other words, there was no clustering of same initial majors within rooms or social groups. The second column shows our examination of whether peers indicated a higher probability of having the same final major. The results indicate an increase in probability of 3.67 percentage points among roommates, compared with cohort mates. Given that cohort mates' probability of having the same final major was 19.87%, this represents an increase of 18.47% in roommates' probability of having the same final major. The peer effects among social group mates were also positive but lower at 0.87 percentage points, which is equivalent to a 4.38% increase in the probability of having the same final major.

The results thus far have indicated that not only did peers influence one another in major-switching decisions (Table 4 and 5), but they also influenced major-destination by choosing the same majors as those of their peers (Table 6). In the final step of the analysis, we investigated major-choice patterns. In particular, we considered choices of major when (1) only one student in a pair changed their major and (2) both students in a pair changed their majors. To do this, we began with all possible student pairs based on final major (i.e., the pairs used in the second column of Table 6) and selected only those pairs with at least one student who changed their major. We further divided this group into two subgroups based on whether one or two students changed their majors.

The results in Table 7 indicate that among pairs of students with one switch, being roommates led to a higher probability of having the same final major by 2.66 percentage points. The peer effect of social group mates was also positive but smaller at 0.51 percentage points. In the second column, the peer effects were much larger among pairs of students who both switched their majors. The results indicate that if both students switched their majors, roommates were 17.30 percentage points more likely than cohort mates to land in the same major. Given that an average pair of cohort mates (who both switched majors) had a 31.82% chance of landing in the same major, peer effects thus increased roommates' chance of landing in the same major by 54.37%. Again, the peer effects among social group mates were lower at 6.51 percentage points, which is equivalent to a 20.46% increase in the probability of having the same final major.

6. Summary and Discussion

We used housing assignment data to investigate the peer effect on students' decisions about their majors. The results revealed strong evidence of peer effects on students' persistence in their majors. First, the number of a student's peers with the same major significantly predicted that student's probability of remaining in their initial major. On average, an additional roommate in the same major reduced a student's likelihood of changing their major by about 2 percentage points. The effect of an additional social group mate was about 0.38 percentage points. An important qualification to this peer effect is that students' decisions to switch their majors were heavily influenced by their peers' decision to switch majors. The influence was especially pronounced among peers with the same initial major. In other words, same-major peers tended to make similar decisions regarding switching majors. The direction of the peer effect echoed most previous studies on major-persistence (e.g., Astin & Astin, 1992; Cohoon, 2001; Griffith, 2010). Nevertheless, the estimated effects size in this study was much smaller. For example, in Griffith (2010), a 10 percentage-point increase in the proportion of female PhD students in STEM fields increased their persistence rates in the same fields by approximately 6 percentage points. This difference could be due to selection bias during the formation of natural peer groups.

Second, we found strong evidence that peers influenced one another in choosing their new majors. While there was no evidence of clustering of same-major pairs within rooms and social groups in students' initial major choices, we found clear evidence that peers were more likely to graduate with the same majors. Our analyses suggest that students were more likely to switch to their peers' majors, and when both students in a pair changed their majors, they were more likely to have chosen the same major. These findings are consistent with the limited literature regarding peer effects on choice of major (Anelli & Peri, 2015; De Giorgi et al., 2010; Lyle, 2007), suggesting that peers not only play an important role in the choice of initial major in college but also influence individuals' preferences for a destination major after those individuals decide to switch majors.

Third, this study examined the variation in peer effect size by peer-to-peer relations, student cohort, and gender. Interestingly, in most cases peer effects at the dormitory room level, both for persistence in and choice of major, were stronger than were peer effects at the social group level, confirming the anecdotal evidence that students are more sensitive to influence from close friends than from acquaintances. This result also suggests that using large groups of students (e.g., all students in a department, cohort, or college) as peers may not be ideal for empirical studies. Therefore, future studies should make careful assumptions about an individual's peer group or use data based on self-reported peer networks.

With regard to policy implications, caution is necessary regarding the external validity of this study because it examined only one college in China and because national higher education contexts vary across countries. With this limitation in mind, we discuss some policy implications. In general, switching majors is not necessarily detrimental to one's education. As in Arcidiacono's (2004) model, a student might decide to switch majors after obtaining more information about different majors (e.g., subject matter or marketability) and their relative strengths and weaknesses. Therefore, switching majors might yield an improved match between students' ability and the specific skills required for a major. Such an improved match often has positive long-term consequences. For example, De Giorgi et al. (2010) found that students who chose a major in which they had ability advantages often had better academic performance, starting wages, and job satisfaction than did students who did not enter the right majors. From this perspective, having peers with different majors is desirable because students are exposed to more information.

This positive view to switching majors is based on a few strong assumptions including that information is accurate and complete and students are capable of making rational decisions. However, information may be inaccurate and incomplete; and individuals are prone to make dynamically inconsistent decisions when responding to temptations (Thaler & Sunstein, 2008). Taking student persistence in STEM majors as an example. There has been a concern about a shortage of college graduates from STEM majors, especially among women and minority groups (e.g., Chen, 2013; Espinosa, 2011). Many students in STEM majors exit the STEM pipeline during college. A recent report by U.S. Department of Education indicated that about 48% of STEM students in 4-year degree programs and 69% of STEM students in 2-year degree programs between 2003 and 2009 had left STEM fields by spring 2009. About half of these leavers switched to non-STEM majors and the other half dropped out college altogether (Chen, 2013). Our results suggest that colleges might be able to mitigate the problem of a leaking STEM pipeline by increasing interactions among STEM students. Possible interventions include, for example, pairing STEM-major students in a room or holding regular social activities for STEM students. Previous studies have also supported this policy implication. For example, Espinosa (2011) found that female STEM students who engaged in academic discussions with peers and joined STEM-related student organizations were more likely to persist. Similarly, Cohoon (2001) argued that insufficient peer support was a major reason for the high attrition rate of female computer science majors. Forming peer groups among STEM students makes peer support more accessible to at-risk students, thereby mitigating the leaking pipeline problem.

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Figure 1:Number of Rooms Housing Multiple Students from the Same High Schools

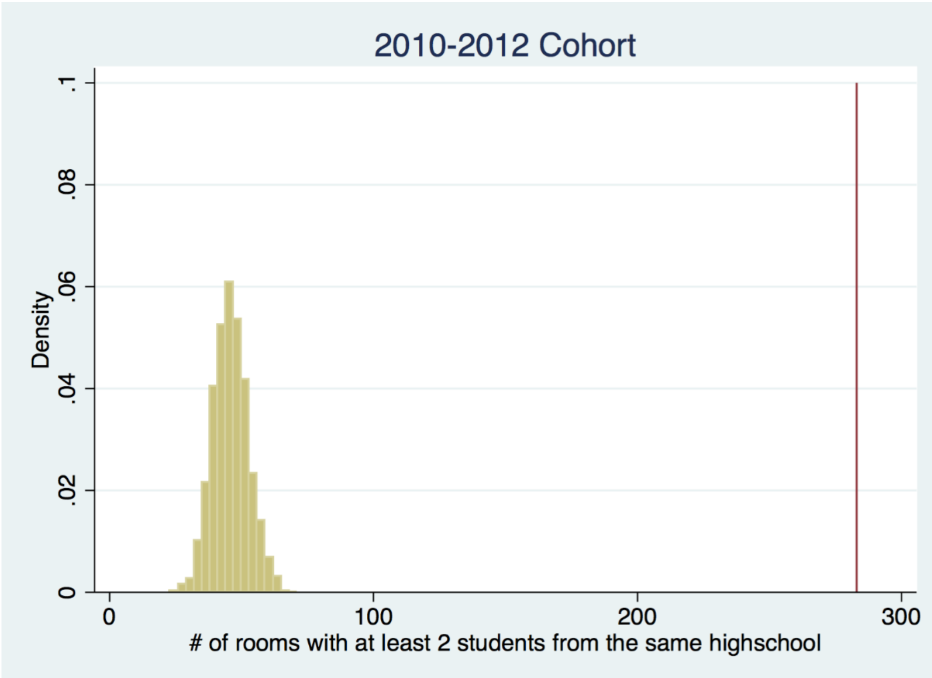

Table 1: Distribution of Top Ten Majors, 2010–2012

Top 10 Majors	2010	2011	2012	Total
Accounting (General)	9.84%	9.61%	6.07%	8.53%
Accounting (Asso. of Chartered Certified Accountants)	1.67%	2.20%	0.00%	1.30%
Accounting (Certified Public Accountant)	49.03%	45.19%	52.20%	48.74%
Audit	1.70%	1.69%	1.64%	1.67%
Construction Cost Estimation	16.44%	16.32%	13.05%	15.29%
Finance (Bank Management)	5.66%	6.74%	8.33%	6.91%
Finance (Corporate Finance)	1.85%	1.99%	2.74%	2.19%
Finance (Investment)	1.82%	2.70%	2.39%	2.31%
Financial Management (Corporate Finance)	3.80%	4.39%	3.52%	3.91%
Industrial Design (Visual Communication Design)	1.63%	0.00%	0.00%	0.53%
Other Majors	6.57%	9.17%	10.06%	8.61%

Table 2: Descriptive Statistics for Full and Reduced Samples

	Full Sample		Reduced Sample		t
	mean	s.d.	mean	s.d.	
% of Female Students	0.700	(0.458)	0.693	(0.461)	-1.458
% from Host Province	0.812	(0.391)	0.805	(0.397)	-1.678
% of Racial Minority	0.023	(0.149)	0.023	(0.151)	0.333
% Registered Online	0.350	(0.477)	0.313	(0.464)	-7.392
% of Science Track in High School	0.347	(0.476)	0.353	(0.478)	1.232
# of Same-Major Roommates	0.897	(0.976)	0.871	(0.962)	-2.554
# of Same-Major Group Mates	13.599	(10.915)	11.917	(9.648)	-16.176
# of Switched Roommates	0.608	(0.782)	0.609	(0.782)	0.132
# of Switched Group Mates	9.501	(4.341)	8.545	(4.000)	-22.144
# of Students Switched Majors	0.200	(0.400)	0.201	(0.401)	0.143
Dormitory Room Size	3.990	(0.439)	3.990	(0.432)	-0.039
Social Group Size	48.178	(5.835)	42.584	(7.593)	-10.471
Sample Size	9732		8602		

Table 3: Correlation Between Individuals' and Their Roommates' Observable Characteristics

	Full Sample	Reduced Sample
College Entrance Exam Score	0.0277	0.0179
	(0.0175)	(0.0186)
Fresh Graduate	0.00767	0.00140
	(0.00564)	(0.00603)
Science Track	0.0178**	0.000293
	(0.00566)	(0.00612)
Minority	0.00257	-0.00502
	(0.00573)	(0.00621)
Majoring in Accounting (General)	-0.000107	-0.00428
	(0.00569)	(0.00606)
Majoring in Accounting (CPA)	0.00448	-0.00292
	(0.00567)	(0.00608)
Majoring in Construction Cost	-0.000761	-0.00438
	(0.00581)	(0.00620)
Control for Registration Type	Yes	Yes
Control for Registration Sequence	Yes	Yes
Control for Building Fixed Effects	Yes	Yes
Sample Size	9732	8602

Standard errors in parentheses, * p<0.05, ** p<0.01, ***p<0.001; 32 students don't have records of College Entrance Exam Scores. Therefore, the corresponding sample sizes are 9695 and 8570 in full and reduced sample when running the random check on College Entrance Exam Score.

Table 4: Peer Effects on the Probability of Switching Major, Linear Probability Model

	All	Cohorts			Gender	
Roommates		2010	2011	2012	Female	Male
# of Same-Major Roommates	-0.0210***	-0.0226*	-0.0172	-0.0185	-0.0232**	-0.0187
	(0.00581)	(0.0104)	(0.00984)	(0.00976)	(0.00767)	(0.0100)
# of Switched Roommates	0.0851***	0.0930***	0.0845***	0.0666***	0.0928***	0.0631***
	(0.00591)	(0.00994)	(0.00931)	(0.0111)	(0.00694)	(0.0114)
N	8570	2920	3034	2616	5946	2624
R-sq	0.086	0.099	0.117	0.047	0.094	0.065
Social Group Mates						
# of Same-Major Group Mates	-0.00382**	0.00265	-0.00840***	-0.00420	-0.00235	-0.00814***
	(0.00139)	(0.00234)	(0.00234)	(0.00263)	(0.00157)	(0.00247)
# of Switched Group Mates	0.0123***	0.0111***	0.0128***	0.00997***	0.0129***	0.0107***
	(0.00124)	(0.00192)	(0.00195)	(0.00240)	(0.00143)	(0.00210)
N	8570	2920	3034	2616	5946	2624
R-sq	0.072	0.078	0.107	0.039	0.075	0.064

Note: Standard errors in parentheses, * p<0.05, ** p<0.01, ***p<0.001. These models also include the list of control variables: from host province, college entrance exam score, fresh high school graduates, science track in high school, minority, cohort fixed effects, peer group size, major program size, random controls (registration type, registration sequence, building fixed effects). 32 students don't have College Entrance Exam Scores. So, the sample used in this table is 8602 minus 32 equals 8570.

Table 5: Peer Effects on the Probability of Switching Major, Linear Probability Model

	All	Cohorts			Gender	
Roommates		2010	2011	2012	Female	Male
# of Same-Major Switched	0.179***	0.150***	0.184***	0.138***	0.174***	0.191***
	(0.0165)	(0.0316)	(0.0297)	(0.0269)	(0.0206)	(0.0295)
# of Same-Major Not Switched	-0.0590***	-0.103***	-0.0844**	-0.0173	-0.0640***	-0.0468*
	(0.0142)	(0.0286)	(0.0262)	(0.0199)	(0.0184)	(0.0225)
# of Diff-Major Switched	0.00501	-0.0286	-0.0227	0.0379	0.00298	0.0104
	(0.0149)	(0.0291)	(0.0262)	(0.0206)	(0.0188)	(0.0232)
# of Diff-Major Not Switched	0.00479	-0.0290	-0.0115	0.0212	0.00215	0.0132
	(0.0134)	(0.0272)	(0.0250)	(0.0179)	(0.0179)	(0.0201)
N	8570	2920	3034	2616	5946	2624
R-sq	0.132	0.151	0.180	0.063	0.143	0.104
Social Group Mates						
# of Same-Major Switched	0.0354***	0.0323***	0.0401***	0.0287***	0.0331***	0.0419***
	(0.00199)	(0.00337)	(0.00326)	(0.00450)	(0.00236)	(0.00412)
# of Same-Major Not Switched	-0.0130***	-0.0108***	-0.0177***	-0.00943***	-0.0118***	-0.0164***
	(0.00128)	(0.00219)	(0.00235)	(0.00217)	(0.00150)	(0.00253)
# of Diff-Major Switched	-0.00363**	-0.00344	-0.00460*	-0.00358	-0.00402*	-0.00260
	(0.00132)	(0.00232)	(0.00218)	(0.00277)	(0.00161)	(0.00224)
# of Diff-Major Not Switched	0.0000689	0.000419	-0.000612	-0.000304	-0.000191	0.000799
	(0.000753)	(0.00136)	(0.00137)	(0.00124)	(0.000918)	(0.00138)
N	8570	2920	3034	2616	5946	2624
R-sq	0.115	0.112	0.161	0.060	0.113	0.122

Note: Standard errors in parentheses, * p<0.05, ** p<0.01, ***p<0.001. These models also include the list of control variables: from host province, college entrance exam score, fresh high school graduates, science track in high school, minority, cohort fixed effects, major program size, random controls (registration type, registration sequence, building fixed effects). 32 students don't have College Entrance Exam Scores. So, the sample used in this table is 8602 minus 32 equals 8570.

Table 6: Peer Effects on Whether Students Have the Same Major

	Same Initial Major	Same Final Major
Roommates	-0.000942	0.0367***
	(0.00458)	(0.00449)
Social Group Mates (but not roommates)	-0.0000813	0.00871***
	(0.00118)	(0.00125)
Both Registered Online	0.0742***	0.0259***
	(0.000445)	(0.000392)
Both Registered Offline	0.0245***	0.00873***
	(0.000217)	(0.000152)
Registered Together	-0.0000501	0.00204
	(0.00318)	(0.00397)
Same Building	-0.00687***	-0.00189***
	(0.000432)	(0.000391)
Both Female	0.0766***	0.0520***
	(0.000287)	(0.000201)
Both Male	-0.0204***	-0.00362***
	(0.000401)	(0.000412)
Constant	0.237***	0.172***
	(0.000263)	(0.000291)
Cohort Fixed effects	Yes	Yes
N	12374282	12374282

Standard errors in parentheses; *p< 0.05; **p< 0.01; ***p< 0.001

Table 7: Peer Effects on Final Major; Breakdown by Subpopulation

	Pairs with One Switch	Pairs with Two Switches
Roommates	0.0266***	0.173***
	(0.00512)	(0.0191)
Social Group Mates (but not roommates)	0.00509***	0.0651***
	(0.00107)	(0.00505)
Both Registered Online	-0.0299***	0.102***
	(0.000569)	(0.00203)
Both Registered Offline	-0.00961***	0.0201***
	(0.000385)	(0.00134)
Registered Together	-0.00194	0.0244***
	(0.00481)	(0.00692)
Same Building	-0.000387	-0.0156***
	(0.000531)	(0.00249)
Both Female	0.0331***	0.0805***
	(0.000288)	(0.00133)
Both Male	-0.00843***	-0.0471***
	(0.000445)	(0.00287)
Constant	0.1000***	0.256***
	(0.000247)	(0.000895)
Cohort Fixed Effects	Yes	Yes
N	3981509	510753

Standard errors in parentheses; *p< 0.05; **p< 0.01; ***p< 0.001