TESTING PEER EFFECT AMONG COLLEGE STUDENTS: EVIDENCE FROM AN UNUSUAL ADMISSION POLICY CHANGE IN CHINA

Fangwen Lu
University of California Berkeley
fangwen@berkeley.edu

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Evidence from an Unusual Admission Policy Change in China

Abstract

This paper studies an unusual change in college admission policy at a prestigious Chinese university, which brought a large number of low-scoring students into several academic departments in the university. Exploiting large variations in peer characteristics and strong interactions among peer groups, the analysis finds that specially admitted low-scoring students have largely reduced the performance of regular students on English tests. This detrimental effect from specially admitted students is concentrated among students whose English ability was below average.

It has long been believed that peers play an important role in determining an individual's behaviors and educational outcomes. Concern with peer effects can be traced back to two thousand years ago in a Chinese story, "Three Moves of Meng's Mother."[1] Peer influence has been noted in a wide range of policy issues, including neighborhood relocation programs, desegregation, academic tracking, and affirmative action (Kling, Liebman and Katz, 2007; Angrist and Lang, 2004; Duflo, Dupas and Kremer, 2007; Card and Krueger, 2005). Understanding the effects of peers on students is important for school management, admission policy, and school choice.

[1] This is documented by Liu, Xiang (BC77–BC6). The story tells that Meng's mother is concerned about their social environments and moves several times to find a good location so that Meng can study well. Eventually, Meng becomes a philosopher famous in Chinese history.

Despite strong academic interest in peer effects, several issues have contributed to a lack of clear evidence on peer effects, especially among college students. Manski (1993) discusses reflection problems and points out that selection bias is one of several major econometric challenges in identifying peer effects. Selection bias arises because individuals choose their peer group, which makes it difficult to separate true peer effect from the selection effect. To circumvent selection bias, Sacerdote (2001), Zimmerman (2003), and Foster (2006) exploit random dormitory assignments in colleges in the U.S., but their findings disagree with each other: some papers report modest but statistically significant peer effects among roommates, while others find little support for the existence of peer effects among college students. Although random dormitory assignment solves the selection bias problem, it is questionable whether roommates are well defined peers. Stinebrickner and Stinebrickner (2006) discuss that college students establish networks of friends extending beyond the roommate level and that interactions among roommates are limited. In other words, roommates may not be close peers, which may explain the modest or non-existent effects reported in these studies. A further issue in the empirical analysis is whether there is enough variation in peer characteristics for precise estimation. Lyle (2007, 2009) identifies peers as students who study and socialize together in a class of 35 students, relieving the weak-peer identifier problem, and he argues that the limited variation in peer characteristics may explain the null effect of the average peer test scores in his sample. The importance of variation in peer abilities is further confirmed by Carrell, Fullerton, and West (2009) who find strong peer effects when peer groups are not constructed to have an even distribution of academic ability.

An unusual change in admission policy at a prestigious Chinese university provides a rare opportunity for studying peer effects among college students. This design addresses selection bias, and leverages strong peer interaction and wide variation in peer characteristics. The change in admission policy brought a large number of specially admitted low-scoring students into many academic departments which normally only admitted students with much higher scores in college entrance exams. The inflow of specially admitted students imposed an exogenous shock for the regular students by changing the composition of students' characteristics in the relevant academic departments. The number of specially admitted students varied across departments; some departments did not admit any low-scoring students whereas in other departments the share of low-scoring students reached as high as 40%. The school arrangement further facilitated the exploration of peer effects because all the specially admitted students lived and studied together with regular students, and students in the same department-year interacted intensively with each other.

This paper adopts a difference-in-difference estimation strategy similar to that presented in Imberman, Kugler and Sacerdote (2009), and explores the relationships among the characteristics of specially admitted students and the test outcomes of the other students. We interpret the estimated effects as causal effects of low-scoring students on their peers given that the following two findings: first, evidence indicates that regular students in the same departments are comparable across years, and the inflow of low-scoring students does not seem to alter the backgrounds of regular students in the affected departments; second, evidence also suggests that omitted variables do not seem to contribute to the estimated effects.

Although one important policy implication of peer effect studies pertains to the optimal design of admission policy, to the best of our knowledge, this is the first analysis on peer consequences of an admission policy change among college students. Our data suggest that specially admitted low-scoring students have significantly reduced the performance of the regular students in College English Tests. The detrimental effects from specially admitted students are concentrated among regular students whose English ability was below average.

This paper is organized as follows. Section 1 provides background information on the admission policy change and the school arrangement in the sample university. Section 2 describes the data and presents the summary statistics. Section 3 describes the estimation strategy and presents results. Section 4 conducts robustness checks to rule out the selection bias and omitted variable bias. Section 5 concludes the paper.

1 Background

In China, college programs are ranked into different rounds in the admission process. Programs in earlier rounds are allowed to admit students earlier. Students admitted by programs in earlier rounds leave the applicant pool and are not available for programs in later rounds. Round 1 universities are the universities whose bachelor programs are allowed to admit students in the first round. In normal years, 1994 and 1995 in this study, Round 1 universities only admitted students for their bachelor programs during the first round.

In 1996, the province of Jiangsu implemented an unusual change in the admission policy and created Round 3 bachelor programs, which allowed several Round 1 universities to admit students for their bachelor programs after Round 2 universities completed bachelor program admission.[2] The middle 1990s saw a large movement in the commercialization of higher education in China, and the creation of Round 3 bachelor programs was one of the trials, which was claimed to serve at least two purposes: to help universities to increase funding and to train human resources for local governments. Given that there are about 150 Round 1 and 750 Round 2 universities, and the sample university is a top-ranking Round 1 university, it is not surprising to see that students admitted through the Round 3 programs differ markedly in educational backgrounds from the regular Round 1 students.

The distribution of Round 3 students varies across departments. Departments related to public affairs, such as public administration, social welfare, and urban planning, were strongly affected; they admitted a larger number of Round 3 students, which conformed to the stated purpose of the Round 3 programs: to train human resources, particularly for local governments. Many departments did not admit any Round 3 students, including both popular departments, such as bio-chemistry and the medical school, and less popular departments, such as geology, astronomy, aerology, and history.

The department-year is the primary unit of affiliation for students. Students are assigned to an academic department in the admission letter before they enter the university. It is difficult for students to change their assigned academic departments, so nearly all students remain with their cohort over their four years of undergraduate study. Round 3 students had much lower scores in

[2] Round 3 programs remain in the following years, but the way of admission changed largely after 1996.

the college entrance exam and paid much higher tuition; except that difference, all bachelor students in the same department-year lived and studied together. All the students lived in university dormitories. Separated by gender, bachelor students in the same department-year are assigned to live together in the same room or neighboring rooms for four years.[3] Students in the same department-year took most classes together in the first two years. Many extracurricular activities are organized within the department-year, including class meetings, sports, trips, parties, and so on.

It is worth noting that many departments held associate degree programs during the studied time period. Since the admission order of the associate programs fell after the Round 2 bachelor programs in 1994 and 1995, associate students might be similar to Round 3 students in 1996 in terms of test performance in the college entrance exam. For the sake of our analysis, the major difference between Round 3 bachelor programs in 1996 and the associate programs in earlier years is that Round 3 bachelor students lived and studied together with Round 1 bachelor students while the associate students did not. Therefore, we treat Round 3 students as peers of Round 1 students but ignore associate students in this analysis.

2 Data

The data for this study come from archived student academic records, which provide information on National College Entrance Exam (NCEE) scores, College English Test (CET) outcomes, and some demographics, such as age, gender, and home address. We identify whether a student is a

[3] Male and female students in the same department-year do not live close to each other.

Round 3 student using the Admission Approval Table, which documents the program to which a student is admitted. The data cover all the students in 23 selected academic departments entering the university in 1994, 1995, and 1996.[4,5]

Most students, except a group of recommended students, took the National College Entrance Exam to be admitted to college. Two sets of exams are administrated every year: the "art" set and the "science" set, each containing five subject exams. The English test is common to both sets. The total score is the sum of scores in the five subject exams. Since the National College Entrance Exam is administrated by each province separately every year and the raw scores are not comparable across years even within provinces, we standardize all the scores using the averages and standard deviations calculated from the corresponding Round 1 students by year, province, and exam set or exam subject.[6] Round 3 students are mainly those who fail to be admitted by Round 1 and Round 2 programs. As the NCEE total score is the major criterion in college admissions, it is expected that the NCEE scores of Round 3 students differ from those of regular students, as illustrated in Figure 1 and Figure 2. Since all Round 3 students are from Jiangsu, we compare the NCEE scores among students from Jiangsu. The top panel of Figure 1 demonstrates the distributions of the NCEE total scores for students in 1994 and 1995 combined, the middle panel displays the scores of regular Round 1 students in 1996, and the bottom panel is

[4] The Archive Office was reluctant to provide data for all departments, but allowed us to choose departments. We acquired data from departments which admitted many Round 3 students and those which did not admit any Round 3 students. We exclude the school of foreign languages and other departments that we suspect experienced structural changes during the period.

[5] For this analysis, we exclude students who do not study English as their first foreign language, who are admitted via the university but then sent to a joint program abroad, and who come from Hongkong, Macau, or foreign countries. For the presented results, we exclude several students who had NCEE scores too low to be regular Round 1 students but who nevertheless cannot be identified as Round 3 students; however, excluding them does not affect the results.

[6] After standardization, the scores are still not comparable across provinces. It is arguable whether the scores are comparable across years within provinces, especially for those provinces with a small number of admission quotas for the sample university, because the allocation of quotas to academic departments tends to vary greatly across years in those provinces.

for the specially admitted Round 3 students in 1996.[7] By construction, the standardized scores of regular students in each province-year are scattered around zero, with a standard deviation of 1. And Round 3 students' NCEE total scores fall mainly between -6 and -2. Figure 2 illustrates the distributions of the NCEE English scores for the same three groups. The English scores of Round 3 students are also largely different from those of Round 1 students too.

We measure students' performance in College English Test Level 4 (CET-4) and Level 6 (CET-6) exams, which offer several advantages over other possible outcomes. First, the CETs are important. Passing the CET-4 is required for all college students to obtain a bachelor degree certificate.[8] Passing CET-6 serves to further signal a student's English ability. The CET certificates are important documents in the job application package. Most students spend more than four hours per week in class for four semesters. Second, CET test outcomes are comparable across departments. The CETs are organized at the national level and graded at the provincial level. In addition, 90% of the score is determined objectively; only 10% of the score is determined by an essay. In general, the grading is reliable and comparable. Third, all the English teachers are from the Division of College English, and they use identical syllabus. Finally, English classes tend to be organized on the department-year basis. If the size of the department-year is large, students will be separated into several classrooms. Students are ordered "alphabetically" according to their last names,[9] and Round 1 students and Round 3 students are mixed in the classrooms.

[7] Students who gain admission via recommendation are not included since they do not have official NCEE scores.
[8] Normally, when they graduate, students can obtain two certificates—a graduation certificate and a bachelor degree certificate. Students can still graduate with a graduation certificate if they could not pass the CET-4. Students can be exempt from the CET-4 if they study another foreign language as their first foreign language or if their major is a foreign language. More than 99% students chose English as their first foreign language. Those who chose other foreign languages had to pass similar tests.
[9] The term "alphabetically" is defined in the Chinese way.

Table 1 presents the summary statistics for the CET outcomes in Panel A. The raw scores for the CETs are in the scale of 0 to 100, and a student earns a "Pass" with a score above 60 and an "Excellence" if the score is above 85. If students fail, they are allowed to repeat the exam, but they can not repeat a Pass to attempt an Excellent. The data are the eventual CET outcomes when students leave the univeristy, and we can only know whether students earn "Pass" or "Excellent" rather than their raw scores. The CET-4 is compulsory in the sense that all the students are required to pass it to be awarded a bachelor degree certificate, so it is not surprising to see that the average CET-4 passing rate is higher than 96% for regular students. Even for Round 3 students, 76% of them passed the CET-4. The CET-6 is voluntary, and passing CET-4 is the prerequisite for taking the CET-6. Given the importance of the CET-6 certificate and the low monetary cost for taking the test, most students took the CET-6 when they were eligible to, and repeated it if they failed. The passing rate of CET-6 is approximately 62% for regular students and 17% for Round 3 students. The "excellent" rates are 19% and 5% for CET-4 and CET-6 respectively for regular students, and are nearly zero for Round 3 students.

Round 3 students are measured in two ways, as shown in Panel B of Table 1. "Round 3 Number" measures the total number of Round 3 students in a department-year. It ranges from 4 to 38 in the affected departments in 1996, and zero otherwise. "Round 3 Share" is the percentage of Round 3 students in a department-year, obtained by dividing the number of Round 3 students by the size of a department-year. Given that the size of a department-year ranged from 15 to 131 in 1996, the department-year with the largest number of Round 3 students does not coincide with the department-year with the largest share of Round 3 student.

The College English classes are organized by the Division of College English. An English class usually consists of only students from the same department-year. If the size of a department-year is large, students will be divided into several classrooms. There is no explicit cap for the class size. We could not obtain precise data on historical class size, but we contacted many students in the relevant department-years and obtained the numbers of English classes the department-years were divided into.[10] We estimated class size by dividing the number of students in a department-year with the number of classes. Class size averaged 27, and ranged from 13 to 37. In 1996, as more students entered the university, the class size increased on average in both affected and unaffected departments. After controlling for department and year fixed effects, class size is significantly correlated with the number and the share of Round 3 students at the conventional level (p=0.05 and 0.02 respectively), so we controlled for the effect of class size in the estimation of peer effects.

3 Estimation

We estimate the impact of Round 3 students on the test performance of regular students in the same department-year as follows,

$$Y_{idt} = \gamma^{d} + \lambda^{t} + \beta\, Round3_{dt} + \eta\, Class_{dt} + \delta\, X_{idt} + e_{idt} \qquad (1)$$

[10] Although it has been more than ten years, the contacted students can report the number of students in their department-years which roughly agree with the numbers in the dataset, so we believe the numbers of classes they report are correct.

where the left-hand variable Y_{idt} is the academic outcome of interest (CET 4 Pass, CET 6 Pass, CET4 Excellence, or CET 6 Excellence) of student i at department d in entering year t; $Round3_{dt}$ is one of the Round 3 indicators; $Class_{dt}$ is the size of the College English class; X_{idt} are the pretreatment characteristics of individual student i at department d of year t, including age, gender, prefecture type, home province, and NCEE scores. Since the NCEE scores are not comparable across provinces, we interacted NCEE English scores with the 26 province dummies to allow for a differential effect of province on NCEE score. For the group of recommended students, who do not have official NCEE scores, their NCEE scores are coded as 0, and we include a dummy variable indicating whether the student is a recommended student. The coefficients γ^d and λ^t capture department and year fixed effects. The addition of department and year effects makes this a difference-in-differences specification in which changes in outcomes before and after 1996 in departments that admitted more Round 3 students are compared to changes in departments that received fewer or no Round 3 students. We report standard errors clustered by departments to account for the possible correlation in the residual e_{idt} in the same department over time. Since all the CET outcomes are binary, and both the CET-4 passing rate and the CET-6 excellence rate are at an extreme, we logistical models for the analysis.[11]

Table 2 reports the empirical estimates of the effect of Round 3 students on the CET-4 passing rate of the regular Round 1 students. The dependent variable equals 1 if a student has passed the CET-4 and 0 otherwise. Each coefficient is from a different regression. In other words, each

[11] We are aware of the potential incidental parameter problem in the panel data setting, but we do not think it is likely in our settings. Our fixed effect is at the department level, and the smallest department contains 45 students. We check the marginal effects estimated from the logistic model with those from the linear probability model. For the CET-6 passing rate, both the magnitudes and the significance levels are similar; for the CET-4 passing rate, the magnitudes are similar, but the logistic model provides more precise estimates, which confirms our expectation that the linear-probability model tends to give less precise estimates when the probability rate is at the extreme end.

column contains estimates from two separate regressions. The coefficients are in log-odds ratios; we calculate the marginal effects at 0.967, the average CET-4 passing rate of regular students in 1994 and 1995. The marginal effects multiplying with 100 can be interpreted as the changes in percentage points. In column 1, we report estimates controlling for the department and year fixed effects only. A one-student increase in the number of Round 3 students in a department-year reduces the rate of passing CET-4 by .14 percentage points. Similarly, increasing the share of Round 3 students from 0 to 1 reduces the passing rate by 13 percentage points. In column 2, we add class size as a control. The effects of Round 3 indicators remain stable in magnitude, but the addition of class size slightly inflates standard errors of Round 3 indicators. Class size does not seem to affect the CET-4 passing rate in any regressions (not reported in the table). From column 3 to column 5, we gradually add individual characteristics, home province dummies, and province-specific NCEE English scores as additional control variables. All the coefficients remains relatively stable as more control variables are added; in the specification with all the control variables, the coefficients are statistically significant at 0.1 and 0.05 respectively for the number and the share of Round 3 students. By multiplying the per-unit reduction with the average levels of Round 3 indicators in the year 1996, we see that Round 3 students have reduced the CET-4 passing rate of the regular students by 1.5 to 2 percentage points, which is comparably large given that the overall failure rate in passing CET-4 is less than 4 percentage points.

Table 3 presents the estimates of the effect of Round 3 students on the CET-6 passing rate of regular students. Unlike CET-4, a pass of which is required for a bachelor certificate, CET-6 is taken voluntarily. The variable “CET-6 Pass” equals 1 if a student takes the exam and passes it

and 0 otherwise. The marginal effect is calculated at 0.640, the average CET-6 passing rate of students in 1994 and 1995. A one-student increase in the number of Round 3 students in a department-year significantly reduces the CET-6 passing rate by about 0.5 percentage points. On average, Round 3 students reduce the CET-6 passing rate in 1996 by more than 5 percentage points. Table 3 also suggests the measurement of peer groups is important. Although all the estimates for Round 3 Number are statistically significant, the share of Round 3 students is not significantly correlated with CET-6 passing rates.

Table 4 and 5 present the estimation results for the excellence rates of CET-4 and CET-6 respectively. All the estimates are negative but none of them is statistically significant. The overall effects of Round 3 students, calculated by multiplying the marginal effect with the average of Round 3 indicators in 1996, are around one half of the standard deviations of the excellence rates, so we interpret these results as little evidence for the effects of Round 3 students on the excellence rates.

As all the CET outcomes are binary, and students with abilities around the cutoffs tend to be affected, the effects of Round 3 students have a local-effect interpretation, even though "local" cannot be not precisely determined. Given that the CET-4 and CET-6 passing rates are 96.2% and 62.4%, and both rates are significantly affected by Round 3 students, we can generally say that Round 3 students have strong negative impacts on the English test performance of regular students whose English ability is distributed around the bottom 5% to 40%. Nothing restricts us to extend the domain of effects to regular students from the lowest to the bottom 40%, or roughly

speaking below average. However, for students with better academic backgrounds in English, we do not find such detrimental effects.

We explore whether there are heterogeneous gender effects along two dimensions. The first is whether male Round 3 students tend to exert more negative impacts than female Round 3 students do. The second is whether male Round 1 students are more affected. Lavy and Schlosser (2007) suggest that boys tend to be more disruptive and violent in Israeli schools, and also boys tend to be more affected by the disruption of other boys. However, we do not find differential effects along either dimension (results are not shown).

4 Robustness Checks

The estimates for Round 3 students only indicate causal interpretations in the difference-in-difference model if we can rule out the following two possible biases: selection bias and omitted variable bias. We explore both of this biases below.

4.1 Selection Bias

Selection bias is a major econometric obstacle in identifying peer effects. Selection bias may have arisen in our sample if the Round 3 admission process discouraged applications for the relevant academic departments and led to the admission of worse regular students in the affected departments in 1996. But the college admission and application system largely rules out this possibility for the following three reasons.

First, Round 3 admission did not affect the application and admission processes in provinces other than Jiangsu. Students' academic department in a college was decided before they enter the college. Applicants had to specify their preferred academic department when they submit the college application. After that, they are not given any further choice and had to accept the university and department to which the admission system assigns them. Thus, only information available at the application stage could possibly affect students' applications. Every year, each province publishes an official brochure containing all the admission quotas allocated to that province.[12] As the Round 3 admission was held only in Jiangsu province in 1996, such information was not available in the brochures published by other provinces. In addition, news about Round 3 admission was not widely disseminated by the media, and even for students who were already on campus before 1996, most of them were unaware of Round 3 admission until Round 3 students eventually entered the campus. Applicants in other provinces were unlikely to know about Round 3 admission when they submitted their applications. Therefore, Round 3 admission was not likely to affect applications and admissions outside of Jiangsu.[13]

Second, many Round 1 universities normally held associate program admissions after the Round 2 bachelor programs, and Round 3 programs in 1996 were placed in a status similar to that of associate programs in previous years. Round 3 programs were deemed merely as additional programs a university or department tended to have, and therefore the introduction of Round 3

[12] If a student applied to a university that does not have a quota allocated for the student's province, the application would not be considered by that university. Information on admission quotas includes the name and the round number of a college and how many students each academic department will admit from that province.
[13] The estimated effects of Round 3 students on regular students' CET outcomes are similar regardless ofwhether we use the subsample of students outside of Jiangsu or the full sample of all students, except that the former gives smaller estimates for the effects on the CET-4 passing rate.

programs was not likely to discourage potential applicants from applying for the bachelor programs.

Third, the "120% rule" in the admission process limited potential selection bias even if potential applicants switched out of the affected departments. The "120% rule" dictates that a university has to use the NCEE total score as the major admission criterion. In particular, it mandates that if a university wants to admit 100 students from a certain province, it can only admit students whose NCEE total scores ranked among the top 120 students of all applicants from that province. Therefore, the variations of students' NCEE scores across academic departments are largely restricted. Then, the university places applicants into academic departments based on students' interests as specified in the application form. Quotas in popular departments are always filled earlier, and less popular departments usually have to admit students who apply for the university but not for their particular department, if those applicants do not refuse. As the strongly affected departments are not among the most popular departments, and they tend to admit students who don't apply for them even in normal years, so Round 3 programs were not likely to have actual effects on admission of affected departments.

To identify whether Round 3 programs have actually affected the characteristics of entering Round 1 students, we conduct the following placebo falsification test,

$$X_{idt} = \gamma^{d} + \lambda^{t} + \beta\, \text{Round3}_{dt} + \varepsilon_{idt} \qquad (2)$$

where X_{idt} represents a background variable of Round 1 student i in department d of the entering year t, and it could be NCEE total score, NCEE English score, or other demographic characteristics. $Round3_{dt}$ indicates Round 3 Number or Share. The coefficients γ^d and λ^t are the fixed effects for departments and years respectively.

If high-scoring potential applicants would switch from an affected department to another department or university, the NCEE total score and English score would be lower in the affected departments in 1996, since their positions have to be filled by other students with lower scores. Because we are particularly concerned about the selection bias among students from Jiangsu, the first two columns in Table 6 focus on regular students from Jiangsu. The admission of Round 3 students is not significantly associated with the NCEE total scores and English scores for regular students from Jiangsu, and all the estimates are positive. The third and fourth columns repeat the same tests for all the students. The NCEE scores are not comparable across provinces and they can be very volatile for students from provinces which only send a small number of students to the sample university each year, so we interpret these results with caution. The number of Round 3 students is positively related to the NCEE total scores at the 5 percent level, which suggests that the affected departments attracted better students. Nevertheless, the effect is opposite to what selection bias would indicate. We also test whether there are changes in students' demographics, including living area, age, and gender. In addition, we check whether the number of recommended students and the number of students from Jiangsu are significantly correlated with Round 3 indicators; these two numbers are not subject to the choice of applicants, but they may affect the quality of attending Round 1 students. Column 5 to 9 in Table 6 show that Round 3 indicators are not significantly related to those characteristics, which suggests that after

controlling for the university yearly effect, students in the same department are comparable across years, and there does not seem to be a selection bias along those aspects either.

If students interested in public administration, social welfare, or city planning decide to switch to other universities because of the Round 3 programs, the introduction of Round 3 programs may increase the mismatch between students' academic interest and their academic department, but we don't think this mismatch is not likely to affect our estimates. English is not associated with any specific academic department and is universally required for all college students, so interest in studying English is not likely to change if a student is placed in a less interested department. Furthermore, in regular years, the majority of students admitted to strongly affected departments do not apply for those departments, so there is limited possibility for additional mismatch. One concrete example is that among 23 entering students in public administration in 1995, fewer than 5 students had specified public administration as their department of interest.

4.2 Omitted Variable Bias

If other phenomena associated with Round 3 admission also occurred in 1996 but went unobserved by our research, we may wrongly attribute the correlation to the causal peer effects from Round 3 students. Suppose, in 1996, the government announced that it would increasingly recruit staff from college students who studied public administration, social welfare, and city planning. The announcement may first motivate the creation of the Round 3 programs. At the same time, the announcement might also affect students' efforts in the relevant departments. For example, regular students entering in 1996 may think that they could find a job more easily than

previous students in the same department might think, and therefore they might put less effort into their studies than the previous students did. In that case, even in absence of Round 3 students, the government announcement would lower academic performance of regular students.

Students were expected to take the CET-4 and the CET-6 by the end of their second and third years respectively. Most students who entered the university in 1994 already passed the CET-4 before the Round 3 admission in 1996. But students entering in 1995 would study for one more year to take the CET-4 after the entry of the Round 3 students. Similarly, for the CET-6, students entering in 1994 studied for one year under the influence of potentially omitted variables if any, while students entering in 1995 were under the two-year influence. For either CET-4 or CET-6, students of 1995 would have experienced the effects from omitted variables, if any, for one more year, compared to students of 1994. Neither 1994 nor 1995 students should be directly affected by the Round 3 students, however, as these students would primarily interact with their 1996 classmates.[14] Therefore, we should be able to detect any possible omitted variable bias with the following equation.

$$Y_{idt} = \gamma^{d} + \lambda^{t} + \beta\ \text{pseudo\_Round3}_{dt} + \eta\ \text{Class}_{dt} + \delta\ X_{idt} + \varepsilon_{idt} \qquad (3)$$

where $\text{pseudo\_Round3}_{dt}$, is generated by assuming that the same Round 3 students were admitted in 1995 rather than in 1996. For students in 1994, $\text{pseudo\_Round3}_{dt}$ is 0. The year t is restricted to 1994 or 1995, and students in 1996 are dropped from the analysis.

[14] If there are any spillover effects between classes, they should go in the same direction as the omitted variables bias, as we discuss below. A null result it thus evidence against both omitted variables bias and spillover effects between classes.

Table 7 shows that Round 3 admissions by departments in 1996 do not predict the test performance of students admitted in 1995 compared to those admitted in 1994 for the same departments. All the results are estimated with the full set of control variables. None of the coefficients is significant at the level of 0.1. For CET-4 and CET-6 passing rates, all the four coefficients are positive, which suggests that the null effects between pseudo_Round3$_{dt}$ and the passing rates are not simply due to a lack of statistical power. Equation (3) will be a valid two-side test for the omitted variable bias under the assumption that there are no spillover effects across students of different years in the same department. Since the spillover effects across years and the omitted variable effects point in the same direction and do not cancel out each other, the null effect of pseudo_Round3$_{dt}$ sustains the assumption of null spillover effects and also indicates that there is no omitted variable bias.

5 Conclusions

This study exploits an unusual change in the admission policy in a Chinese university, and examines the impact of specially admitted low-scoring students on the academic performance of their classmates. The arrangements in the sample university facilitate the study of peer effects because the specially admitted students lived and studied together with regular students in the same department-year. The exogenous inflow of specially admitted students, the large differences in academic backgrounds between specially admitted students and regular students, and the strong interactions among these two groups overcomes the well-documented empirical problems associated with identifying peer effects.

Our estimates suggest that specially admitted low-scoring students strongly reduced the College English Test passing rates of regular students in the same department-years. On average, specially admitted students reduced the CET-4 passing rate by 1.5 to 2 percentage points, a sizable proportion given that the overall failure rate of the CET-4 is less than 4%. The specially admitted students also significantly affected whether regular students passed the CET-6 and reduced the passing rate of that test by more than 5 percentage points. However, the presence of specially admitted students does not seem to have significantly impacted the overall attainment in terms of of excellence rates.

To our best knowledge, this is the first study on peer effect consequences of an admission policy change among college students, and it sheds some light to potential outcomes of college admission policy changes. In addition, this study analyzes peer effects in a developing country setting, and extends our understandings of peer effects among college students to a larger context.

References

Angrist, Joshua D., and Kevin Lang. 2004. "Does School Integration Generate Peer Effects? Evidence from Boston's Metco Program." American Economic Review, 94(5):1613-1634.

Card, David, and Alan B. Krueger. 2005. "Would the Elimination of Affirmative Action Affect Highly Qualified Minority Applicants? Evidence from California and Texas. Industrial and Labor Relations Review, 58(3):416-434.

Carrell, Scott E., Richard L. Fullerton, and James E. West. 2009. "Does Your Cohort Matter? Measuring Peer Effects in College Achievement." Journal of Labor Economics, 27(3):439-464.

Duflo, Esther, Pascaline Dupas, and Michael Kremer. 2008. "Peer Effects and the Impact of Tracking: Evidence from a Randomized Evaluation in Kenya." National Bureau of Economic Research Working Paper 14475.

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

Imberman, Scott, Adriana D. Kugler, and Bruce Sacerdote. 2009. "Katrina's Children: Evidence on the Structure of Peer Effect from Hurricane Evacuees." National Bureau of Economic Research Working Paper 15291.

Kling, Jeffrey R., Jeffrey B. Liebman, and Lawrence F. Katz. 2007. "Experimental Analysis of Neighborhood Effects." Econometrica, 75(1):83-119.

Lavy, Victor, and Analia Schlosser. 2007. "Mechanisms and Impacts of Gender Peer Effects at School." National Bureau of Economic Research Working Paper 13292.

Lyle, David S. 2007. "Estimating and Interpreting Peer and Role Model Effects from Randomly Assigned Social Groups at West Point." Review of Economics and Statistics, 89(2): 289–99.

Lyle, David S. 2009. "The effects of Peer Group Heterogeneity on the Production of Human Capital at West Point." American Economic Journal: Applied Economics, 1(4):69-84.

Manski, Charles F. 1993. "Identification of Endogenous Social Effects: The Reflection Problem." Review of Economic Studies, 60(3): 531–42.

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

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

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

Table 1: Summary Statistics

Panel A: CET Performance (Academic Achievements)	Students[1]	Mean	SD	Minimum	Maximum
Round 1 students					
CET-4 Pass	3020	0.962	0.191	0	1
CET-6 Pass	2966	0.624	0.485	0	1
CET-4 Excellence	2689	0.189	0.391	0	1
CET-6 Excellence	2966	0.047	0.211	0	1
Round 3 students					
CET-4 Pass	229	0.760	0.428	0	1
CET-6 Pass	229	0.166	0.373	0	1
CET-4 Excellence	213	0.005	0.069	0	1
CET-6 Excellence	229	0	0	0	0
Panel B: Class Characteristics					
	Department years	Mean[2]	SD[2]	Minimum	Maximum
Round 3 Number in 1996	23	12.74	11.42	0	38
Round 3 Share in 1996	23	0.151	0.119	0	0.403
Class size in all years	69	26.91	5.501	13	37
Panel C: Baseline Characteristics					
	Students	Mean	SD	Minimum	Maximum
Round 1 students					
Age entering college	3020	18.45	0.795	15.5	22.75
Being male	3020	0.678	0.467	0	1
From Rural areas	3020	0.279	0.449	0	1
From Jiangsu	3020	0.503	0.500	0	1
Being recommended student	3020	0.572	0.232	0	1

Note:
1. The changing number of students is due to the data availability. The CET-6 outcomes are missing for students in the department of biology-medicine in 1996. The department of computer science does not provide data on the CET-4 excellence if a student passes CET-6, therefore we code CET-4 excellence to be missing for all the students in computer science.
2. They are weighted by the number of regular students in the department-years.

Table 2: Effects of Round 3 Students on CET-4 Pass of Regular Students

	Dependent Variable: CET-4 Pass				
Key Predictors	(1)	(2)	(3)	(4)	(5)
Round 3 Number	-0.0435**	-0.0446**	-0.0435*	-0.0410	-0.0438*
	(0.0205)	(0.0223)	(0.0243)	(0.0265)	(0.0254)
Marginal Effect	-0.0014	-0.0014	-0.0014	-0.0013	-0.0014
Round 3 Share	-4.0090***	-4.1790**	-4.2993**	-4.1179**	-4.6274**
	(1.5319)	(1.6511)	(1.9075)	(2.0429)	(2.0589)
Marginal Effect	-0.1279	-0.1334	-0.1372	-0.1314	-0.1477
Observations	2540	2540	2540	2528	2528
Control Variables					
Department Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Class size	-	Yes	Yes	Yes	Yes
Individual characteristics	-	-	Yes	Yes	Yes
Province Fixed Effects	-	-	-	Yes	Yes
NCEE English scores	-	-	-	-	Yes

Notes: Each estimate is from a different logistic regression. The coefficients are in log odds ratios. The dependent variable is whether a regular Round 1 student passed the CET-4, which is equal to 1 if pass and 0 otherwise. The unit of observation is a student entering the sample university in the years 1994, 1995 and 1996. Individual characteristics include age, age squared, gender and living in rural or unban areas. NCEE English scores are interacted with home province dummies to allow differential effects of NCEE English scores from provinces on CET performances. Standard errors clustered by department in parenthesis. Marginal effects are calculated at p=0.967, the average CET-4 passing rate of students in 1994 and 1995.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

Table 3: Effects of Round 3 Students on CET-6 Pass of Regular Students

	Dependent Variable: CET-6 Pass				
Key Predictors	(1)	(2)	(3)	(4)	(5)
Round 3 Number	-0.0223***	-0.0250***	-0.0255***	-0.0242**	-0.0238**
	(0.0074)	(0.0093)	(0.0097)	(0.0103)	(0.0105)
Marginal Effect	-0.0051	-0.0058	-0.0059	-0.0056	-0.0055
Round 3 Share	-0.9867	-1.1392	-1.1316	-1.0148	-0.9326
	(0.7030)	(0.7608)	(0.9471)	(0.9583)	(0.8387)
Marginal Effect	-0.2273	-0.2625	-0.2607	-0.2338	-0.2149
Observations	2966	2966	2966	2966	2966
Control Variables					
Department Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Class size	-	Yes	Yes	Yes	Yes
Individual characteristics	-	-	Yes	Yes	Yes
Province Fixed Effects	-	-	-	Yes	Yes
NCEE English scores	-	-	-	-	Yes

Notes: Each estimate is from a different logistic regression. The coefficients are in log odds ratios. The dependent variable is whether a regular Round 1 student passed the CET-6, which is equal to 1 if pass and 0 otherwise. The unit of observation is a student entering the sample university in the years 1994, 1995 and 1996. Individual characteristics include age, age squared, gender and living in rural or unban areas. NCEE English scores are interacted with home province dummies to allow differential effects of NCEE English scores from provinces on CET performances. Standard errors clustered by department in parenthesis. Marginal effects are calculated at p=0.640, the average CET-6 passing rate of students in 1994 and 1995.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

Table 4: Effects of Round 3 Students on CET-4 Excellence of Regular Students

	Dependent Variable: CET-4 Excellence				
Key Predictors	(1)	(2)	(3)	(4)	(5)
Round 3 Number	-0.0093	-0.0139	-0.0128	-0.0129	-0.0158
	(0.0080)	(0.0097)	(0.0100)	(0.0109)	(0.0119)
Marginal Effect	-0.0015	-0.0022	-0.0020	-0.0021	-0.0025
Round 3 Share	-0.7974	-1.2957	-1.1671	-1.1984	-1.5089
	(0.7661)	(0.8333)	(0.9247)	(0.9758)	(0.9978)
Marginal Effect	-0.1273	-0.2069	-0.1864	-0.1914	-0.2410
Observations	2689	2689	2689	2665	2665
Control Variables					
Department Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Class size	-	Yes	Yes	Yes	Yes
Individual characteristics	-	-	Yes	Yes	Yes
Province Fixed Effects	-	-	-	Yes	Yes
NCEE English scores	-	-	-	-	Yes

Notes: Each estimate is from a different logistic regression. The coefficients are in log odds ratios. The dependent variable is whether a regular Round 1 student obtained an Excellence in the CET-4, which is equal to 1 if pass and 0 otherwise. The unit of observation is a student entering the sample university in the years 1994, 1995 and 1996. Individual characteristics include age, age squared, gender and living in rural or unban areas. NCEE English scores are interacted with home province dummies to allow differential effects of NCEE English scores from provinces on CET performances. Standard errors clustered by department in parenthesis. Marginal effects are calculated at p=0.200, the average CET-4 excellence rate of students in 1994 and 1995.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

Table 5: Effects of Round 3 Students on CET-6 Excellence of Regular Students

	Dependent Variable: CET-6 Excellence				
Key Predictors	(1)	(2)	(3)	(4)	(5)
Round 3 Number	-0.0166	-0.0163	-0.0161	-0.0154	-0.0211
	(0.0179)	(0.0180)	(0.0201)	(0.0203)	(0.0231)
Marginal Effect	-0.0009	-0.0009	-0.0009	-0.0009	-0.0012
Round 3 Share	-1.0528	-0.9954	-1.0158	-0.9478	-1.8736
	(1.0389)	(1.3505)	(1.4898)	(1.5269)	(1.9538)
Marginal Effect	-0.0594	-0.0561	-0.0573	-0.0535	-0.1057
Observations	2679	2679	2679	2420	2420
Control Variables					
Department Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Class size	-	Yes	Yes	Yes	Yes
Individual characteristics	-	-	Yes	Yes	Yes
Province Fixed Effects	-	-	-	Yes	Yes
NCEE English scores	-	-	-	-	Yes

Notes: Each estimate is from a different logistic regression. The coefficients are in log odds ratios. The dependent variable is whether a regular Round 1 student obtained an Excellence in the CET-6, which is equal to 1 if pass and 0 otherwise. The unit of observation is a student entering the sample university in the years 1994, 1995 and 1996. Individual characteristics include age, age squared, gender and living in rural or unban areas. NCEE English scores are interacted with home province dummies to allow differential effects of NCEE English scores from provinces on CET performances. Standard errors clustered by department in parenthesis. Marginal effects are calculated at p=0.060, the average CET-6 excellence rate of students in 1994 and 1995.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

Table 6. Testing for Exogeneity of Round 3 Students

	Pretreatment Variables								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Key Predictors	NCET Total Score Jiangsu	NCET English score Jiangsu	NCET Total score All	NCET English score All	Rural Area	Entering Age	Being Male	From Jiangsu	Recommend students
Round 3 Number	0.0052	0.0017	0.0061**	-0.0035	-0.0010	0.0009	0.0008	0.0019	-0.0004
	(0.0048)	(0.0043)	(0.0028)	(0.0026)	(0.0012)	(0.0011)	(0.0025)	(0.0012)	(0.0006)
Round 3 Share	0.7232	0.3286	0.5156	-0.2244	-0.0894	0.0978	-0.0954	0.1832	-0.0392
	(0.5027)	(0.4472)	(0.4077)	(0.2888)	(0.1258)	(0.1128)	(0.2757)	(0.1407)	(0.0579)
Observations	1409	1409	2847	2847	3020	3020	3020	3020	3020
Controlled for:									
Department Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Each estimate is from a different linear regression. The unit of observation is a student entering the sample university in the years 1994, 1995 and 1996. Standard errors clustered by department in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

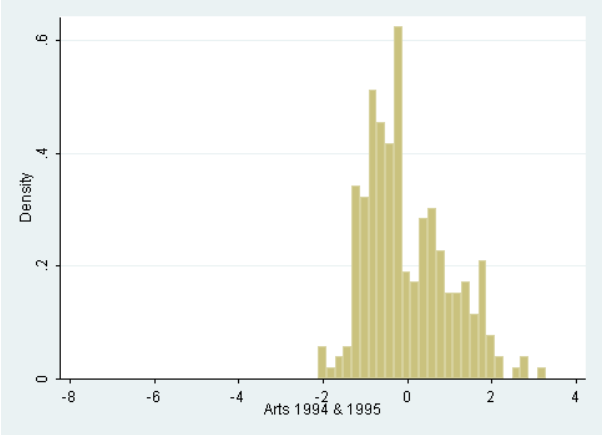
Table 7: Placebo Testing

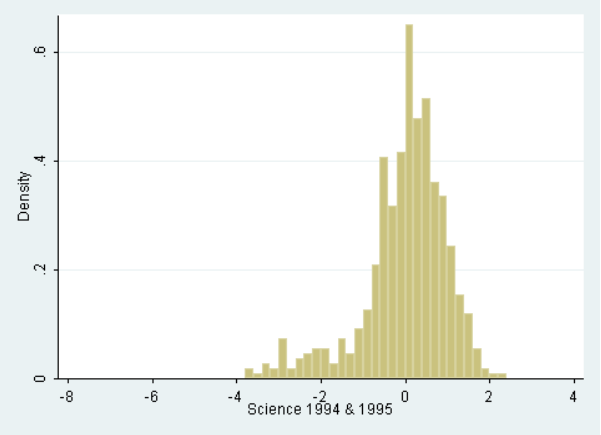
	Dependent Variables			
Key Predictors	CET-4 Pass	CET-6 Pass	CET-4 Excellence	CET-6 Excellence
Round 3 Number	0.0351	0.0057	-0.0070	0.0154
	(0.0377)	(0.0098)	(0.0100)	(0.0231)
Round 3 Share	5.5657	1.3942	-1.1653	1.0935
	(3.5670)	(1.1969)	(1.3002)	(2.1866)
Observations	1283	1847	1650	1448
Control Variables				
Department Effects	Yes	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes	Yes
Class size	Yes	Yes	Yes	Yes
Individual Characteristics	Yes	Yes	Yes	Yes
Home province	Yes	Yes	Yes	Yes
NCEE English scores	Yes	Yes	Yes	Yes

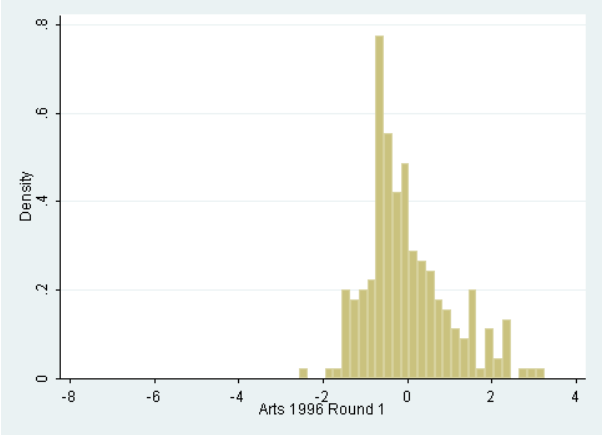
Notes: Each estimate is from a different logistic regression. The coefficients are in log odds ratios. The unit of observation is a student entering the sample university in the years 1994 and 1995 but not in 1996. Individual characteristics include age, age squared, gender and living in rural or unban areas. NCEE English scores are interacted with home province dummies to allow differential effects of NCEE English scores from provinces on CET performances. Standard errors clustered by department in parenthesis.

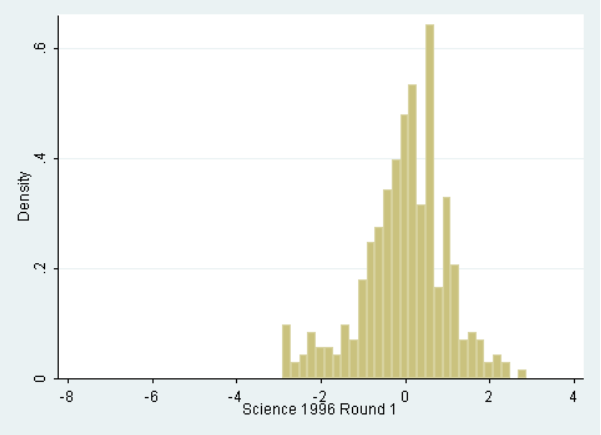
* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

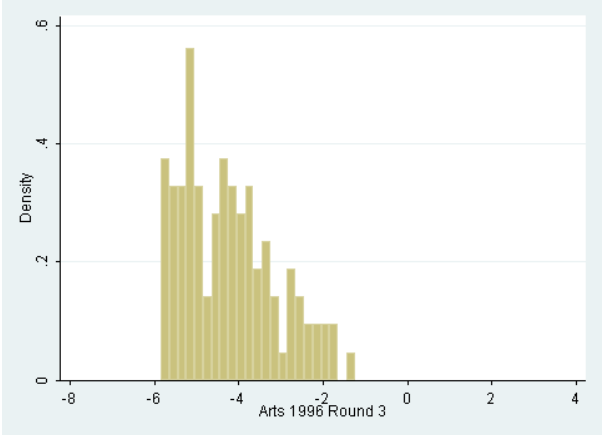
Figure 1. Distribution of NCEE Total Scores











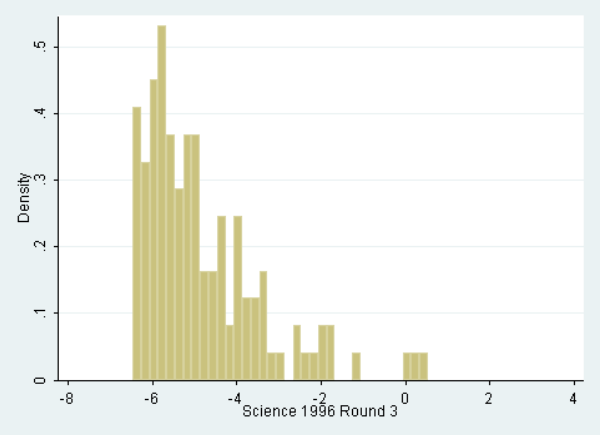


Figure 2. Distribution of NCEE English Scores