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Social policy gone bad educationally: unintended peer effects from transferred students

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Abstract
Policy makers frequently use education as a welfare policy instrument. We examine one such case, where students from large and financially constrained families, were given the opportunity to be transferred to university departments in their hometown as part of the social policy of the Ministry of Education in Greece. Multiple law changes meant that there was a large and quasi-random variability in the number of transferred students over time, which was orthogonal to the quality of receiving students. We construct a novel dataset by linking students' characteristics and pre-university academic performance with their university academic record until graduation for the top economics department. We present consistent evidence showing how a social policy that is meant to help poor families and to alleviate inequalities has gone bad educationally, by lowering the academic performance of receiving students.

Keywords: peer effects, externalities, university education, unintended consequences
JEL: H52; I2

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1. Introduction

Education, with its multifaceted role, is a key social policy instrument that has been used to address inequality of opportunities and the structure of society by mixing students from various socioeconomic backgrounds in public schools, by allowing school choice, or through specific policies, such as affirmative action in university admissions, or desegregation programs in schools. Such policies are strongly predicated upon the assumption of significant positive peer effects. At the same time, education has often been used as a welfare policy tool to help disadvantaged families, while ignoring those peer education externalities. In this paper, we analyze one such case, where university access is used as a (non-cash transfer) social policy to help large and financially constrained families.

To gain university entry, students in Greece participate in a national examination system. Based on their grades and their declared preferences, students get allocated to different universities and departments. After this allocation, the Ministry of Education operates a special transfer system, as part of its social policy, to assist large and financially constrained families. This policy is giving students from such families the opportunity to "transfer" to a similar subject university department in (or near) their hometown, in case they had successfully gained entry to a university department far from home. The policy purpose was to help financially those families to pool their resources, by not needing to maintain a second household in a different city. However, transferred students were of lower academic quality than receiving students, thus raising the possibility of exerting a negative externality on their receiving peers. Various recent changes in the relevant legislation meant that there was a large, quasi-random, variability in the number of transferred students over time, creating serious problems both at the leaving and at the receiving departments. Yet, despite the importance of this policy and the resulting highly inefficient redistribution of students, there is no systematic study of the effects of this policy on either the transferred or the receiving students.

In this paper we present the first systematic examination of transferred university students' impact on the academic performance of receiving students. The empirical literature reports mixed evidence on peer effects so far. At the university level, peer effects are modest if non-existent for academic performance (Paloyo, 2020). We construct a novel dataset from the best undergraduate economics department in Greece, by linking students' personal and pre-university academic performance characteristics with their entire university academic performance record until graduation. Analyzing the data, both at the aggregate (course) level and at the individual student level, we provide consistent evidence showing that transferred students exert a large negative externality on receiving students. Overall, our research shows how a social policy that is meant to help financially constrained families and to alleviate inequalities has gone bad educationally, by lowering the academic achievements of receiving students.

Besides the policy evaluation angle, our research contributes more broadly to the large and growing literature of peer effects in education. First, we study a unique policy change that has created quasi-random variation at the class level for university education. In the typology of Sacerdote (2014), we belong to the "exogenous movement of people" category of natural experiments, such as the busing of Metco students in Angrist and Lang (2004), the Hurricane Katrina evacuees of Imberman et al. (2012), the ending of court-ordered desegregation in Billings et al. (2014), the Moving To Opportunity experiment in Kling et al. (2005) or the refugees and immigrants in Gould et al. (2009). One important difference is that we look at a university environment rather than schools, as all these papers. In addition, in our setup we have a large influx of lower ability students into the classroom, creating conditions for negative peer effects. If externalities matter in education, our natural experiment complements existing literature that typically searches for positive peer effects (see, for example, Feld and Zölitz, 2017; Carrell, Sacerdote and West, 2013; Booij, Leuven and Oosterbeek, 2017). Past empirical evidence shows that peer effects at the university level, are somewhat modest, if non-significant

for academic performance (Sarcedote, 2001; Zimmerman, 2003; Stinebrickner and Stinebrickner, 2006; Carrell et al., 2009; Feld and Zölitz, 2017; Booij et al., 2017).

Second, having pre-university information and a large panel data on university performance for both the receiving and transferred students, allows us to control for student heterogeneity. Our identification relies on the exogeneity of the inflow of transferred students with respect to the changes in peer quality in a given course and examination period. Multiple changes in the relevant legislation meant that, from the point of view of the receiving students, the number of transferred students joining each class varied widely, while clearly following an upward trend since 2004. These legislation changes were orthogonal to the characteristics of the receiving students entering each year through the national examinations. We take advantage of this quasi-natural experiment variation created by the frequent legislative changes to estimate the impact that these transferred students exerted on the receiving student population. We examine the academic performance on the core courses that all students must take to graduate, to avoid any selection issues. Hence, our identification strategy addresses the usual issues related to selection and reflection that are common in peer effects studies (Angrist, 2014).

Third, we test the nature of peer-to-peer interactions and the existence of non-monotonicities across the quality spectrum of receiving students. We contribute to an important literature that tries to understand, not just the existence, but also the root causes and the distributional aspects of peer effects, such as Hoxby and Weingarth (2006) or Imberman, Kugler and Sacerdote (2012) in the US, Lavy, Paserman and Schlosser (2012) in Israel or Duflo, Dupas and Kremer (2011) with their experimental work in Kenya. Finally, we uncover a specific channel of transmission of peer effects that in our case has to do with the type of courses taken. We show that transferred students, being weak in mathematics, seem to exert a strong negative externality specifically in the courses that have a heavy mathematics or statistics component, in line with previous findings

(Carrell, Fullerton and West, 2009; Carrell and Hoekstra, 2010; Feld and Zölitz, 2017; Golsteyn, Non and Zölitz, 2021).

The remainder of the paper is organized as follows. Section 2 introduces some background information on university entry and the social policy related to transferred students, together with the data collected and some descriptive analysis. The empirical framework used is presented in section 3. Section 4 presents the main results and discusses heterogeneity and the likely channels through which the main effect operates, alongside several robustness checks. Section 5 concludes.

2. Background on university entry and social policy through transferred students

2.1 University entry system in Greece

Students finishing secondary education in Greece obtain a school completion certificate, known as "apolytirio". This certificate and the grades achieved are detached from highest education's entrance, although of course they provide a good signal for the students' academic merits. To gain university entry students must participate in a national examination system, known as the panhellenic examinations, that takes place after school graduation. The panhellenic exams overall grade is calculated as a weighted average of the scores of different courses, with one subject having a higher weight. These exams are common across all students applying for university entrance, while the courses differ according to the proposed field of study. For example, any student applying to study economics is examined in four courses: mathematics, Greek language, history and political economy/sociology, with mathematics having a higher weight. After the exams, students declare their preferences by ranking different departments and

universities. Then the system clears allocating the students with the highest grades to their most preferred departments up to the maximum number of students allowed in each department.[4]

2.2 Social policy through transferred students

After the allocation of students into the different universities and departments, the Ministry of Education operates a special transfer system, as part of its social policy to assist large and financially constrained families. The system was initially focused on large families (with four or more children) that had household income below a certain threshold. The policy was giving students from these families the opportunity to "transfer" to a similar subject university department in (or near) their hometown, in case they had successfully gained entry to a university department far from home. The policy purpose was to help implicitly large and financially constrained families pooling their resources by not needing to maintain a second household in a different city.

Until 2003 the law was more restrictive, as it required both that students were a member of a large family and that the household income was below a given threshold. From 2004 on, there was a separation of these two criteria. That meant that any student, whose family income was below the given threshold, could apply to get transferred to departments in their hometown through this policy. Universities had no authority to check whether the declared to the tax authority household income was true or not (for instance, due to the widespread tax evasion during that period, see, for example, Artavanis, Morse and Tsoutsoura, 2016). As a result, there was a large increase in the number of transferred students creating serious problems both at the leaving and at the receiving departments.[5] Despite the importance of this policy and the resulting

[4] The number of maximum students in each department is decided centrally by the Ministry of Education and slightly fluctuates every year, taking into consideration various parameters including, building capacity, number of faculty etc.

[5] Unfortunately, there are no aggregate statistics about the magnitude of this problem. However, we were able to gather many examples from various sources documenting the spread and magnitude of this issue. Just few examples, from the academic year 2009-2010, to highlight the distortions created. Receiving departments: Department of

highly inefficient redistribution of students, there is no systematic study of the effects of this policy on either the transferred or the receiving students.

2.3 Data

We construct a novel dataset from the top[6] undergraduate economics department in Greece. We link, for the first time, students' personal (gender, school type attended, home town) and background academic performance characteristics *before* university entry (school grades, panhellenic exams grades, order of preference, order of entry, etc.) with their entire university academic performance history (courses, grades) for all graduates who enrolled between 1996 and 2008.[7] For each student we also have information on whether they were transferred from another department. Our aim is to examine the impact of transferred students on the receiving students who have entered through the national examinations.

2.4 Descriptive evidence and analysis

Figure 1 plots the total number of students enrolled each year ("Total students") and also split between the students entering through the national examinations ("Receiving students"), the transferred students ("Transferred students") and a third category ("Other students") that includes students entering through special rules and regulations, such as students with disabilities, students coming from abroad, etc.[8] As we can see, even though the total number of students oscillates, it does not increase substantially after 2004. The change in legislation led to

Business Administration in the Athens University of Economics and Business had 250 students entering through national exams and also received 218 transferred students; Department of Accounting in Technological Education Institute of Piraeus had 150 students entering though national exams and also received 257 transferred students. Leaving departments: Department of Mathematics of the University of Aegean had 210 students entering through national exams from whom 118 students departed; Department of Primary Education of the University of Aegean had 250 students entering through national exams from whom 116 students departed. (Source: Ministry of Education, minister Ioannis Panaretos, 31/03/2011, http://panaretos-opengov.eu/?p=6184)

[6] This is the economics department with the highest students' grades based on the national examination system, but also the best in terms of publications and citations per faculty member.

[7] Data was linked based on an anonymized identifier. All data remains strictly anonymous.

[8] These students also take national examinations, but they enter under a special quota system. The number of students admitted in these special categories is rather stable until 2002, following a slightly negative trend since.

a fast increase in the number of transferred students from just 17 in 2003 to 70 in 2008, which is just over a quarter of the total number of students that year. The number of transferred students increased mainly at the expense of students entering through national exams, but also at the expense of students from the other special categories.

Since 2004, there have also been multiple changes in the relevant legislation for transferred students, pertaining to the income threshold, the entry semester, the passed courses in the previous institution and the maximum percentage of transferred students allowed.[9] As a result of these yearly changes, transferred students were arriving at different semesters of their studies, having completed different number of courses at their initial institutions and hence, taking different number of courses in the receiving institution. As Figure 2 shows, the percentage of transferred students joining each core class varied widely, while clearly following an upward trend since 2004.

These legislation changes were orthogonal to the characteristics of the receiving students entering each year through the national examinations. In Table A1 in the Appendix, we regress each pre-determined characteristic of the receiving student population on an indicator variable that is one if transferred students were present in that particular class, while controlling for course, enrollment year and year-examination period fixed effects. None of the coefficients are significant, indicating that the receiving students' composition of classes with or without transferred students was indistinguishable. We take advantage of this random variation created by the frequent legislative changes to estimate the impact that the transferred students exerted on the receiving student population.

Looking at the academic performance of transferred versus receiving students before and during their studies, three facts stand out. First, transferred students have lower academic

[9] Article 1 of L. 3282/2004 (A' 208)

performance than receiving students before entering the university. Both their school grades (Figure 3), but most importantly their performance on the standardized national examination exams (Figure 4) are significantly lower than those of their receiving peers, both overall (left graph in Figures 3 and 4) and in each year (right graph in Figures 3 and 4). Moreover, looking at the distribution of grades of receiving students after 2003 in either Figure 3 or Figure 4 we can see that the cohorts are roughly of equal academic quality. Second, transferred students take longer[10] than receiving students to graduate, as we can see in Table 1. Third, transferred students graduate with statistically significantly lower grades (at any percentile) than receiving students, as we can see in Figure 5.

Table 2 provides summary statistics of some key characteristics and their differences across the transferred and receiving student populations. There is a larger and statistically significant percentage of females among transferred students. This may have a positive effect as Levy and Schlosser (2011) show that an increase in the proportion of female students improves both male and female student cognitive outcomes.[11] Moreover, transferred students are more likely not to have attended a private school, consistent with the idea that they come from more financially constraint families. Most importantly, transferred students have on average lower academic credentials before entering university and their academic performance lags that of the receiving students until graduation.

However, the key question we want to analyze is whether the presence and increasing number of transferred students exerts any influence on the academic performance of receiving students. On the one hand, if the number of transferred students in a given class is small, one

[10] To graduate, students must successfully pass a number of courses. Students in any university in Greece are allowed to follow a course and take the exams multiple times, until successfully achieving a grade of at least 5 out of 10. That means that there is no upper limit on the semesters/years that a student can be registered until graduation. Hence, although most subject fields are nominally 4-year degrees, low performing students can take significantly longer to graduate.

[11] This positive compositional effect is mediated through lower levels of classroom disruption and violence, improved inter-student and student-teacher relationships and lessened teachers' fatigue.

could hypothesize that their impact during lectures would be limited. Moreover, assuming that transferred students are the worst performers in exams, this might even help receiving students get higher grades, if some kind of grade normalization took place. On the other hand, one could envisage that these large differences in academic capabilities could have a negative impact on the receiving students. Transferred students may find it difficult to follow the pace in classes, may delay or distract too much the lecturers with questions, hence making class too easy or boring and exerting a negative externality on their receiving peers. Therefore, the impact of transferred students on receiving students is theoretically ambiguous.

Against this background, Figure 6 plots the average grade of receiving students (right-hand axis) and the percentage of transferred students by enrollment year (left-hand axis). While the average grade of receiving students was increasing until 2003, since then it follows a strong negative trend. At the same time, while the percentage of transferred students was either zero or very small until 2003, since then it experiences a phenomenal increase reaching more than a quarter of student population after just five years. The negative association between the share of transferred students and the average grade of receiving students after 2003 provides an indication of a strong negative externality. Next, we subject these unconditional statistics to more rigorous econometric tests.

3. Empirical framework of the impact of transferred students

To analyze the impact of transferred students on receiving students' academic performance we proceed in three steps. In the first step we look at this relationship at the aggregate level. In the second step, we utilize a reduced form value-added specification using micro data. In the third step, we estimate a standard linear-in-means model of peer effects to quantify the overall impact and to measure any differential effects. In all specifications we focus on the core courses

that all students must take to graduate to avoid any issues related to students' self-selection into different elective courses.

We start by looking at the impact of transferred on receiving students at the aggregate level. Following Angrist and Lang (2004), we estimate the following equation:

$$\overline{y}_{ct} = \alpha + \beta Transfer\_Fraction_{ct} + \Gamma Exam\_Period_t + \Delta Enrollemt\_Year_t + \Pi Course_c + \varepsilon_{ct} \qquad (1)$$

where, $\overline{y}_{ct}$ is the average academic outcome (grade[12] or pass[13]) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester)[14], $Transfer\_Fraction_{ct}$ is the number of transfer students divided by the total number of students taking course c at examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollemt\_Year$ are cohort fixed effects. The coefficient β measures the effect of fraction of transferred students on receiving students' peer means.

Our second approach uses micro data and adds controls for student characteristics and estimates a value-added specification, similar to Imberman, et. al. (2012), in the following way:

$$y_{ict} = \alpha + \beta Transfer\_Fraction_{ct} + \delta GPA_{i(t-1)} + \Omega X_{it} + \Gamma Exam\_Period_t + \Delta Enrollemt\_Year_t + \Pi Course_c + \varepsilon_{ict} \qquad (2)$$

where, y_{ict} is now the academic outcome (grade or pass) of receiving student i in course c at examination period t, $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period and X_{it} are observable student characteristics, including indicators

[12] This is the grade 0-10 achieved in this particular course and examination.
[13] This is an indicator variable that takes the value one if the grade achieved was above or equal to 5/10.
[14] Each year there are three examination periods in February, July and September.

for gender, private high school graduate, whether family home address is in the same city as the university, whether that department was the student's first choice, whether student majored in mathematics at high school, as well as, the student's high school average grade and ranking upon entering the university based on the national examinations. This value-added specification allows us to focus on the impact of the increase in transferred students on changes in performance relative to a receiving student's average university grade so far.

The coefficient β measures the peer effects stemming from the fraction of transferred students on receiving students' performance in a particular course and class/examination, while controlling for various student characteristics. In Manski's (1993) terminology this represents exogenous peer effects since they originate from peers' backgrounds. For β to represent a causal impact of the transferred students to receiving students' grades, we need $Transfer\_Fraction_{ct}$ to be uncorrelated with unobserved course-grade characteristics after controlling for student i's average university grade up to that examination period and a large number of student characteristics. Hence, we do not need the share of transferred students to be uncorrelated with course characteristics and the baseline achievement of receiving students. Rather, we need only for transferred shares in a course to be uncorrelated with changes in course quality and receiving students' performance that occur for reasons other than the arrival of the transferred students.

In our third step, we proceed to estimate standard linear-in-means models of peer effects as follows:

$$y_{ict} = \alpha + \rho\overline{y}_{-ict} + \delta GPA_{i(t-1)} + \Omega X_{it} + \Gamma Exam\_Period_t + \Delta Enrollemt\_Year_t + \Pi Course_c + \varepsilon_{ict} \qquad (3)$$

where, $\overline{y}_{-ict}$ is the contemporaneous average peer academic performance (grade or pass) in course c at examination period t excluding student i. The peer effect coefficient ρ includes the impact from both peers' backgrounds and their current outcomes now, so in the terminology of

Manski (1993) it includes both exogenous and endogenous peer effects. As discussed in the peer effect literature (see, Sacerdote, 2014, and Paloyo, 2020, for reviews), the ρ coefficient is likely biased due to course selection (weaker students may self-select into "easier" courses), but also due to the reflection problem.[15] We eliminate these biases by focusing on the core courses (that all students must take to graduate) and by instrumenting for the average peer score with the fraction of transferred students taking the course in a specific examination. Thus, the identifying assumption is that, after controlling for the student's university grade so far and individual background characteristics, as well as for course and examination period fixed effects, the share of transferred students is uncorrelated with current performance of the receiving student other than through peer effects.

4. Results

We standardized all variables to have zero mean and standard deviation equal to one (over the estimation sample) to simplify the interpretation of coefficients. All reported standard errors are clustered at the course level.

4.1 Main Results

4.1.1 Aggregate level results

Table 3 provides the results from estimating the impact of transferred on receiving students at the aggregate level using equation (1). The first four columns utilize the average grade as the dependent variable, whereas the last four the average percentage of receiving students who passed the course. Column 1 shows that the fraction of transferred students exerts a significant

[15] The reflection problem is that both the individual and its peers exert an effect on each other that is determined simultaneously and hence it is impossible to distinguish one from the other.

negative effect on the average grade of receiving students. One standard deviation increase in transferred students leads to a 0.5 standard deviation decrease in grade on average. Column 2 shows that this effect is non-linear, and it increases significantly moving from the first to higher quartiles of the fraction of transferred students. In other words, the larger the fraction of transferred students in a given class, the bigger the negative impact on the average grade of receiving students in class.

Column 3 is similar to column 1 except that we also control for the total number of students in class. The coefficient on the fraction of transferred students barely changes, as the estimate on the total number of students is not statistically significant. As we show in the descriptive part earlier, the total number of students enrolled each year has not fundamentally changed over the years. The larger fraction of transferred students came at the expense of other student categories and did not essentially increase the total number of students. Hence, the negative externality identified is not simply a "mechanical" result of an increase in the number of students in class. Column 4 confirms this result and shows that the non-linear effects remain largely unchanged when we also control for the total number of students.

Column 5 shows that the fraction of transferred students is also negatively influencing the percentage of receiving students passing a course. Column 6 highlights again that this negative effect is nonlinear and increases in magnitude as the fraction of transferred students increases. Columns 7 and 8 demonstrates that the total number of students plays no significant role and does not affect quantitatively or qualitatively the results. Therefore, overall, there is strong indication that the fraction of transferred students exerts a negative externality on the academic performance of receiving students, at least at the aggregate level.

4.1.2 Reduced form results

Table 4 reports the results from equation (2) on students' grades using micro-level data.[16] Column 1 shows that the fraction of transferred students in a given course and examination period exerts a statistically significant negative effect. One standard deviation increase in transferred students decreases grades by 0.1 standard deviations, on average. That is, a 10% increase in the transferred students, decreases the receiving student's grade by 0.2, on average.[17] Concurrent average GPA has a strong positive influence on the grade achieved. Column 2 adds all the background information that we collected for each individual student. Although a number of those characteristics are significant and most have the expected signs, they seem to exert very small influence on the coefficient of the fraction of transferred students. Columns 3 and 4 estimate separate models for female and male receiving students. The estimated coefficients are of similar magnitude, although more statistically significant in the case of male students. Last four columns divide the population of receiving students in quartiles based on grades achieved in the national examinations for university entry. Estimated coefficients now indicate that transferred students exert a stronger negative effect on the weaker receiving students. This effect decreases and becomes statistically insignificant for the top-quality quartile of students.

Table 5 reports similar results from equation (2) but now using the indicator of whether the student passed the course as the dependent variable.[18] Column 1 shows again that the fraction of transferred students exerts a strong negative influence. One standard deviation increase in transferred students decreases the probability of passing the course by 0.05 standard deviations,

[16] Here we focus attention to the coefficients on the fraction of transferred students and the GPA up to that exam period. The full table is reported in Table A2 of the Appendix.
[17] Estimated coef. × sd grades = -0.087 × 2.467 = -0.2. In our sample, there has been a 25% increase in transferred students between 2001 and 2008. This is associated with a 0.7 decrease in the receiving student's grade.
[18] Again, we focus attention to the coefficients on the fraction of transferred students and the GPA up to that exam period. The full table is reported in Table A3 of the Appendix. Table 5 and A3 use linear probability methods. We also estimate the same specifications using a logit model (Table A4). None of the estimated results change in any fundamental way.

on average. That is, a 10% increase in the transferred students, decreases the receiving student's possibility to pass a course by 0.02, on average.[19] This negative influence remains similar in column 2, where we control for all other individual characteristics. Columns 3 and 4 shows that the impact is equivalent for female and male receiving students. The last four columns split the receiving student population into quality quartiles (based on their national examination grades) and highlight that students in the top quartile seem to be rather immune from that negative influence, whereas the effect is pretty strong and homogenous for the rest of students.

4.1.3 Linear-in-means peer effect results

Table 6 summarizes the results for the linear-in-means model of peer effects when we use the fraction of transferred students in course c at examination period t as an instrument for the average quality of peers.[20] Column 1 reports the results from equation (3) where we do not include the full list of individual characteristics. The first stage coefficient is negative and significant, indicating again that an increase in the fraction of transferred students has a negative impact on the average performance in class. The second stage estimate of peer effect is positive and significant and in the order of 0.3 standard deviations.[21] In terms of the Greek university grading scale, that means that, for example, an increase of peer GPA from 5 to 6 is associated with a grade increase from 5 to 5.24. This effect is considerably larger, compared to what Feld and Zolitz (2017) find; although they find a statistically significant positive peer effect, it is economically insignificant.[22] Booij et al. (2017) conduct a different exercise, where they

[19] Estimated coef. × sd pass = -0.050 × 0.498 = -0.02. In our sample, there has been a 25% increase in transferred students between 2001 and 2008. This is associated with a 6.2% decrease of the receiving student's probability to pass the course, on average.
[20] The full table with all coefficients is reported in Table A5 of the Appendix.
[21] Our estimates are much larger than those of Lavy et al. (2012), where they report that a one standard deviation increase in the proportion of repeaters leads to a decrease of between 0.015 and 0.036 of a standard deviation in the average score of regular (middle and high-school) students, as well as Angrist and Lang (2004) who report modest peer effects from the METCO program on incumbent school students.
[22] In terms of the Dutch grading scale, Feld and Zolitz (2017) find that an increase of peer GPA from 6.5 to 7.0 is associated with a grade increase from 6.5 to 6.523.

experimentally manipulate the ability composition of student groups in the University of Amsterdam, to study if student outcomes can improve through ability grouping. They find that low- and medium-ability students gain on an average 0.19 standard deviations units of achievement by switching from ability mixing to three-way tracking (i.e., to a more homogenous group in terms of ability), while high-ability students are unaffected.[23] Adding all the individual characteristics in column 2 marginally decreases both the first and second stage estimates, without fundamentally changing the results. Columns 3 and 4 report similar results when we use the binary indicator pass instead of grade as the dependent variable. The fraction of transferred students exerts a negative influence on the probability of successfully passing a course examination and at the same time there is a strong positive peer effect at the class level.

4.2 Nonlinearities across academic ability

The presence of strong peer effects naturally raises the question of whether these effects are homogeneous across both the receiving and transferred students. To examine this question, we start by looking whether peer effects differ by academic quality level of receiving students by expanding equation (3) as follows:

$$y_{ict} = \alpha + \rho_1 \overline{y}_{-ict} \times \mathrm{D}_{Q1} + \rho_2 \overline{y}_{-ict} \times \mathrm{D}_{Q2} + \rho_3 \overline{y}_{-ict} \times \mathrm{D}_{Q3} + \rho_4 \overline{y}_{-ict} \times \mathrm{D}_{Q4} + \delta GPA_{i(t-1)} + \Omega X_{it} + \Gamma Exam\_Period_t + \Delta Enrollemt\_Year_t + \Pi Course_c + \varepsilon_{ct} \quad (4)$$

where, D_{Q1} is an indicator of whether receiving student i panhellenic exam entry score is in quartile $k = 1,2,3,4$ of the receiving distribution for year t.[24] The instruments now are the interactions of the fraction of transferred students with the receiving students' quartile.

[23] Ability mixing: students are grouped together irrespective of their GPA (*i.e.* randomly). Three-way tracking: students are grouped together depending on whether their GPA is in the bottom, middle or top tertile.

[24] k=1 is the bottom quality quartile in the distribution of national examination grades of the receiving students. For robustness we also used quartiles of the high school grades distribution. Results remain qualitatively the same (results not reported here, available upon request).

Table 7 reports the results with grade as the dependent variable in columns 1 and 2 and indicator of whether the student passed the particular exam in columns 3 and 4. Columns 2 and 4 also control for the full list of individual characteristics. A necessary condition of the linear in means model is that the peer effect is the same regardless of the student's position in the academic performance distribution, i.e. $\rho_1 = \rho_2 = \rho_3 = \rho_4$. This is confirmed in statistical tests for all four columns.[25] Hence, the level of peer effects does not seem to differ significantly across the academic quality range of receiving students.

Last, we estimate a fully nonlinear specification, following Hoxby and Weingarth (2006) and Imberman, et. al. (2012). First, we classify both receiving and transferred students by their pre-university achievement quartiles (national examination grades quartiles[26]). Second, we estimate separate regressions for receiving students in each quartile on the percentages of transferred students in their class and examination who fall in each quartile as follows:

$$E(y_{ict}/Q_k) = \alpha + \beta_{q1} Transfer_{Fraction_{Q1ct}} + \beta_{q2} Transfer_{Fraction_{Q2ct}} +$$

$$\beta_{q3} Transfer_{Fraction_{Q3ct}} + \beta_{q4} Transfer_{Fraction_{Q4ct}} + \Omega X_{it} + \Gamma Exam_{Period_t} +$$

$$\Delta Enrollemt_{Year_t} + \Pi Course_c + \varepsilon_{ct} \qquad (5)$$

where, Q_k is the receiving student's i panhellenic exam entry score quartile k. Results are reported in Table 8, with panel A looking at the grades as the dependent variable and panel B whether the student successfully passed the particular exam. As seen in both tables, the vast majority of coefficients are not statistically significant indicating that the negative effects of transferred students are pretty homogeneous across the academic quality spectrum of receiving students. The only significant results appear again for the weakest receiving students (column 2,

[25] Results not reported here, available on request.

[26] k=1 is the bottom quality quartile in the distribution of national examination grades of the receiving students. q_1=1 is the bottom quality quartile in the distribution of national examination grades of the transferred students. We also performed the analysis using their high school grades distribution and the results remain unchanged (results not reported here, available upon request).

bottom quartile), corroborating our previous findings from Tables 4 and 5 that the weakest students are the ones mostly affected compared to the rest of receiving students.[27]

4.3 Differences across experience and types of courses

Following discussions we had with lecturers and teaching stuff at the department, we also examine two additional channels of heterogeneity. First, we explore whether the negative externality due to transferred students is stronger for students in their first year as opposed to more mature students. The idea was that students in their first year would be more vulnerable to negative externalities due to their inexperience with the whole university educational process. Estimating model (3) separately for first year versus older students though did not reveal any significant differences.[28] Our conjecture is that this is due to the fact that transferred students were arriving at different semesters of their studies, as we also argued in the descriptive section 2.4, having completed different courses at their initial institutions and hence mixing with receiving students at different semesters. As a result, the timing of the interaction of transferred students with the receiving ones does not seem to materially matter.

Second, we investigate whether the nature of the core courses taken has any differential effect. In particular, we note that the main academic weakness of transferred students was in mathematics: this is the course with the largest weight in national entry examinations and it is also fundamental knowledge for someone to perform well in an economics degree. The argument is that if someone is weak at mathematics, this will not only affect their academic performance but may also affect negatively his class participation. A weak student may start asking too many questions or being slow to follow, which may impact the whole class. This negative externality

[27] For comparison, Imberman et al. (2012) find that a 10 percentage point increase in the fraction of "evacuees from the lowest quartile of the statewide distribution" is associated with a reduction in test scores for top-quartile incumbents of 0.17 standard deviation.
[28] Results not reported here, available on request.

may be more obvious or incapacitating in a statistics or econometrics class, than in a microeconomics or macroeconomics class.

To test this claim we divide all core courses into two broad categories: courses that analyze different aspects of (micro and macro) economics and courses with a stronger mathematics component, such as mathematics for economists, statistics and econometrics. We estimate our baseline linear in means peer model (3) separately for these two groups of courses. Table 9, columns 1 and 2 report the results for the econ and the math-related courses, respectively, when we use the grades achieved as the dependent variable. The differences are striking: for the econ-related courses both the impact of transferred students in the first stage coefficient and the peer effect in the second stage are not statistically significant. On the contrary, both the first and second stage for math-related courses in column 2 are strong and significant[29] with the expected signs. Similarly, when we use the indicator for whether the student successfully passed the examinations in a given course, we see that the first stage coefficient is larger and the second stage estimate is also stronger and more significant in column 4 for the math-related courses than in column 3 for the econ-related courses.

We interpret this as an important nuance to existing theories on mechanisms through which peer effect operate: transferred students seem to exert a negative externality specifically in the courses that are weakest and where class homogeneity perhaps matters the most. This finding suggests that much of this negative externality to the receiving students can be perhaps

[29] Our standardized peer effect estimate for the grades of math-related courses is 0.31 (0.04) and for the econ courses 0.13 (0.23). These results are comparable to those of Imberman et al. (2012) when they look at students who relocated to other schools due to the Katrina hurricane. They report estimates of 0.33 (0.15) in math and 0.00 (0.27) in reading scores regarding elementary school students, and 0.15 (0.08) in math and 0.08 (0.08) in reading scores for middle and high school students. At the university level, the results are mixed. In line with Carrell et al. (2009), Brunello et al. (2010) find larger peer effects in technical subjects, working with data from a middle-sized university in southern Italy. On the other hand, Arcidiacono et al. (2012), using transcript data from the University of Maryland, compare peer effects in humanities, social sciences, hard sciences, and mathematics, and find larger effects for humanities and social sciences. Moreover, Feld and Zölitz (2017) do not detect any significant differences in peer effects between technical and non-technical subjects among students in Maastrict university.

addressed, if education policies are designed to minimize the discrepancies between transferred and receiving students in their background in such courses.

5. Conclusions

Governments around the world often use education for a variety of policy targets, including as a welfare policy instrument. In this paper we analyze one such case, where the Ministry of Education in Greece operates a special transfer system for university students. The policy is giving students from large and financially constrained families the opportunity to transfer to a similar subject university department in or near their hometown, in case they had successfully gained entry to a university department far from home. Various policy changes meant that there was a large (quasi-random) and growing variability in the number of transferred students over time, creating serious problems both at the leaving and at the receiving departments.

In this paper we present the first systematic examination of impact on academic performance of transferred on receiving university students using a detailed novel dataset from the top undergraduate economics department in Greece. We contribute to the literature by showing that transferred students, who in our setting are by default of lower ability than their receiving counterparts, exert a large negative externality on receiving university students. This effect is stronger at the lowest quartile of the ability distribution and becomes less intense as we move to higher quartiles, leaving the top quartile intact. Additionally, we detect the existence of peer effects and although we do not find support for strong non-linearities, we do find consistent evidence that it is the weakest students that are mostly affected compared to the rest of receiving students. We highlight that in our setting the negative externality mainly operates through courses that are heavy on mathematics and statistics. Overall, our research shows that a social

policy that is meant to help alleviating inequalities has the unintended consequence of lowering the academic performance of receiving students.

Our analysis only looks at this policy through the lenses of receiving students. A more holistic evaluation would also examine the impact of this policy from the transferred students' point of view. Moreover, our research uses data only from a top department in a particular field. From a policy perspective it would be of great interest to look at similar evidence from other departments and also from different academic fields. We leave these questions for future research.

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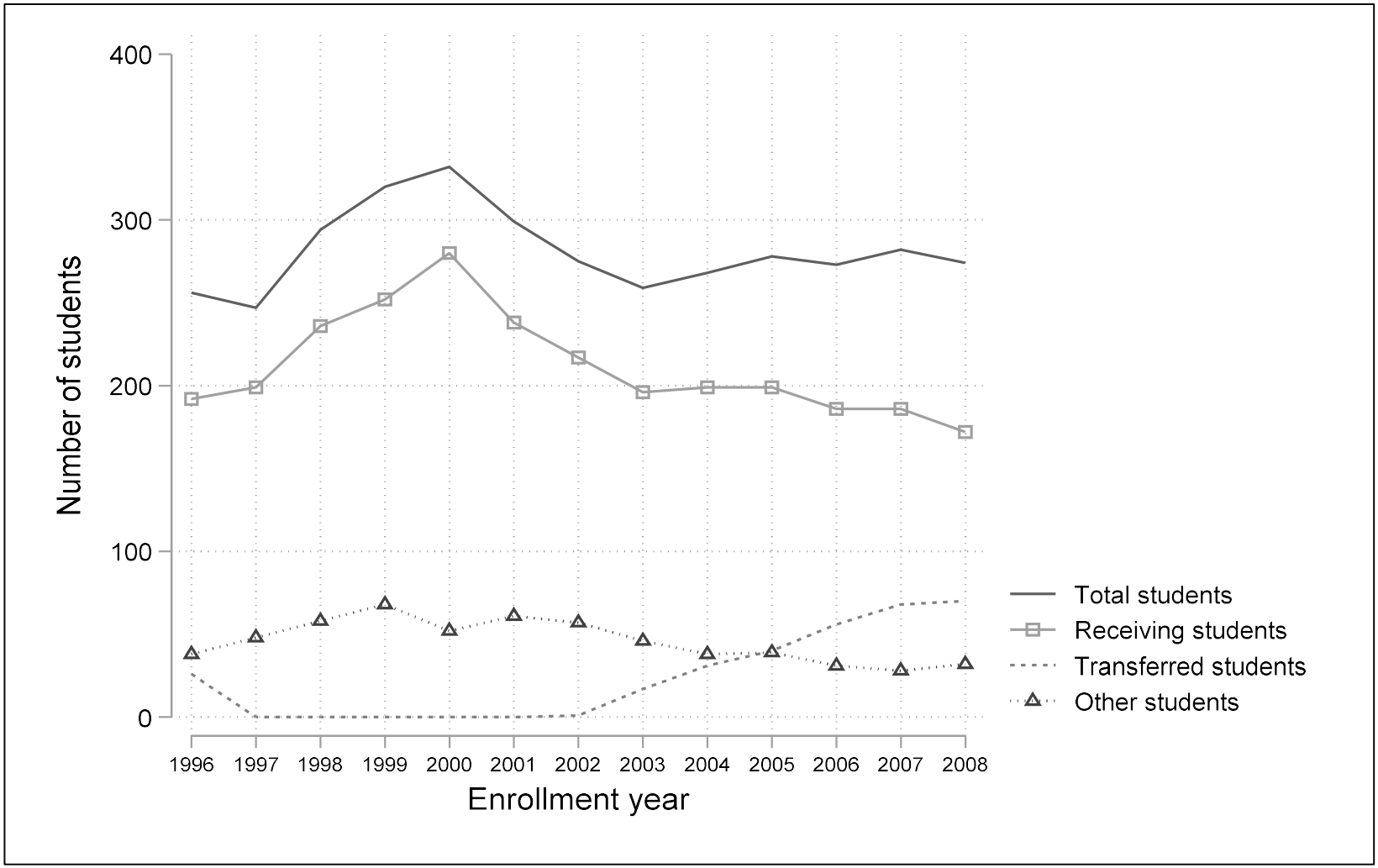
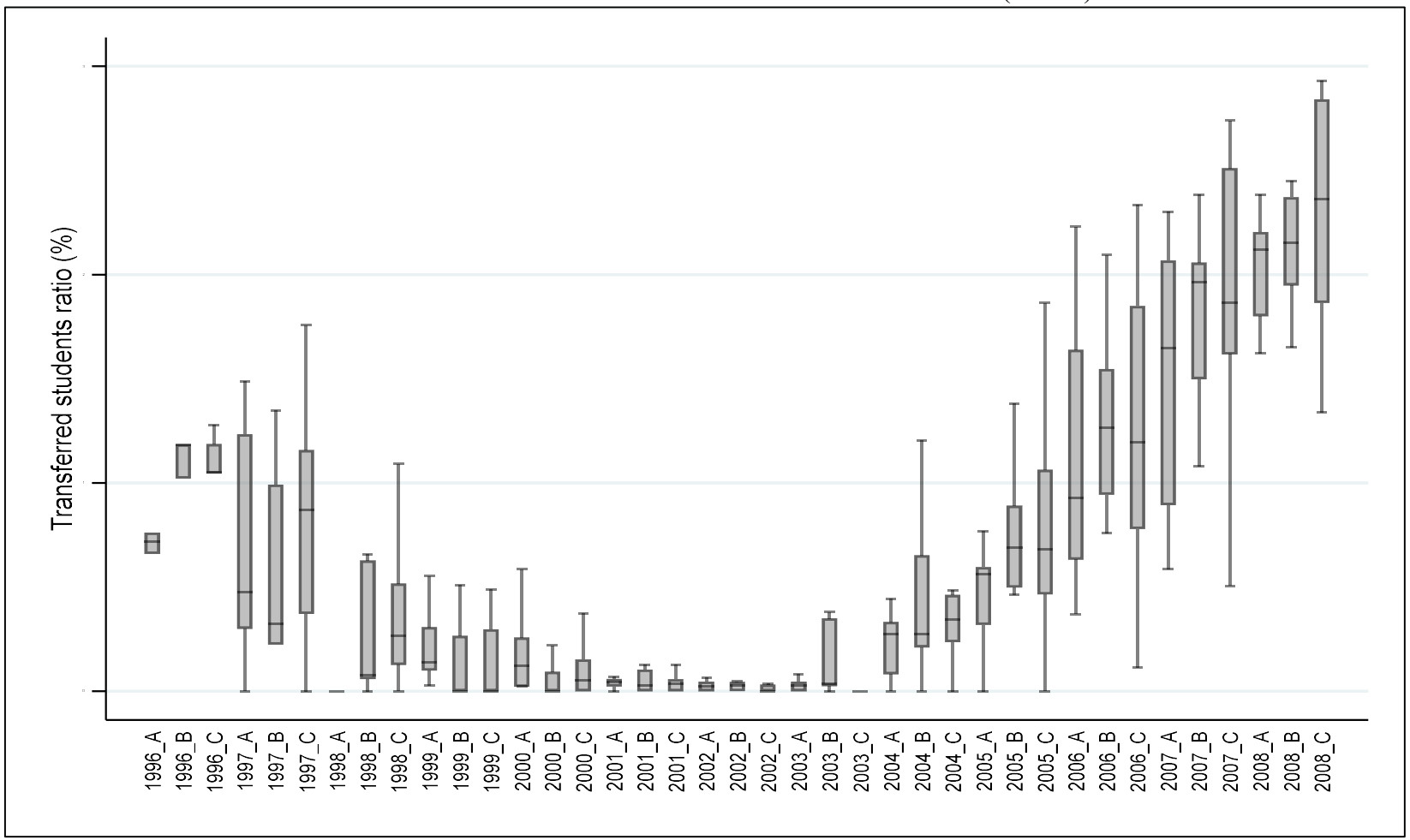
FIGURE 1: NUMBER OF STUDENTS BY ENROLLMENT TYPE



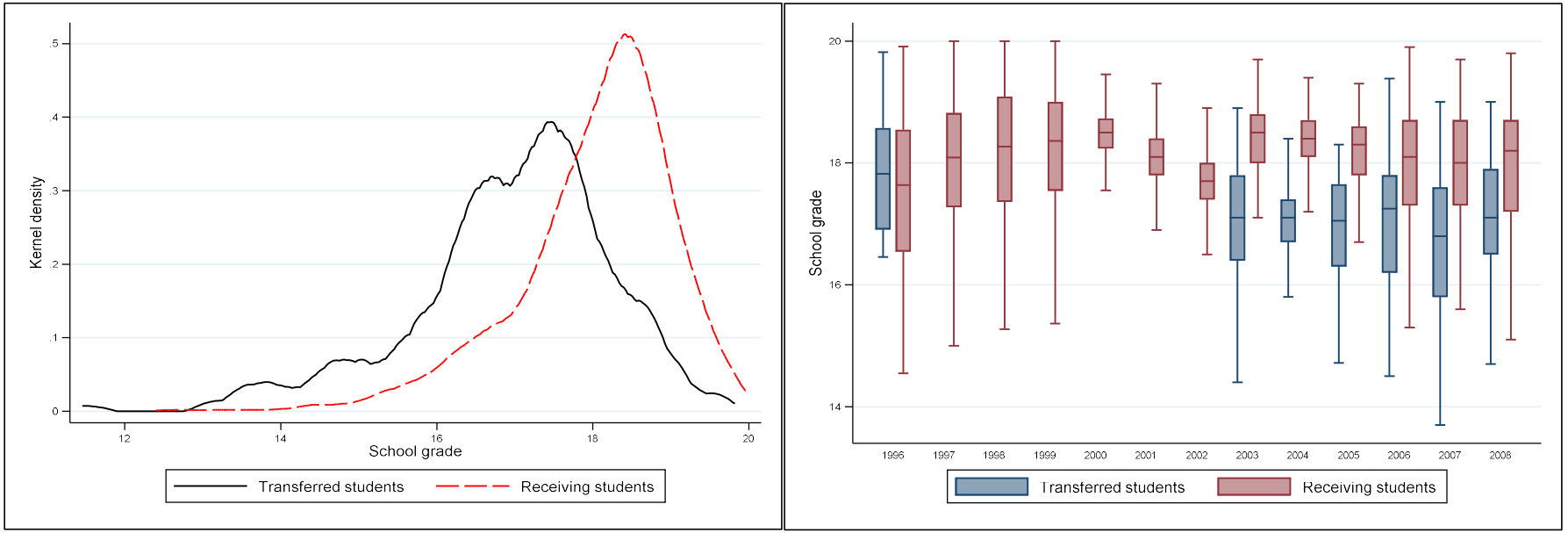
Notes: The figure plots the total number of students enrolled each year (Total students) and also splits between students entering through the national examinations (Receiving students), transferred students (Transferred students) and a third category (Other students) that includes students entering through special rules and regulations.

FIGURE 2: AVERAGE RATIO OF TRANSFERRED STUDENTS BY (CORE) COURSE



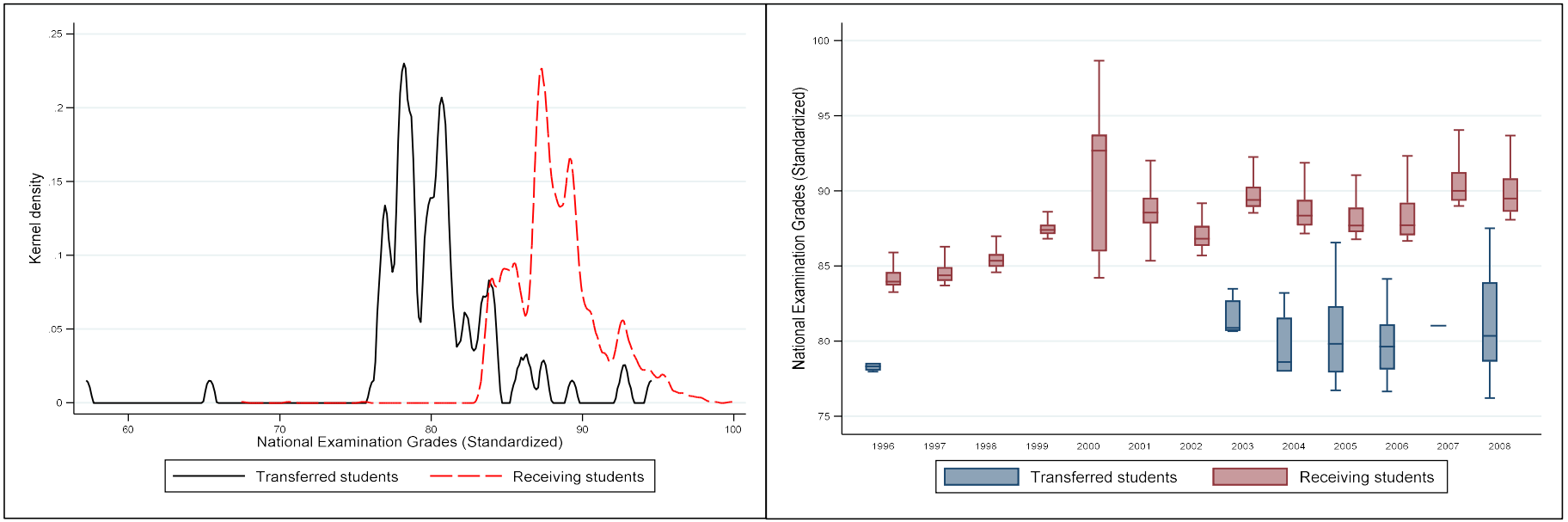
Notes: The figure plots the ratio of transferred students in core courses in each exam period. There are 39 exam periods in total, corresponding to three exam periods every academic year between 1996 and 2008.

FIGURE 3. SCHOOL GRADES BY ENROLLMENT TYPE



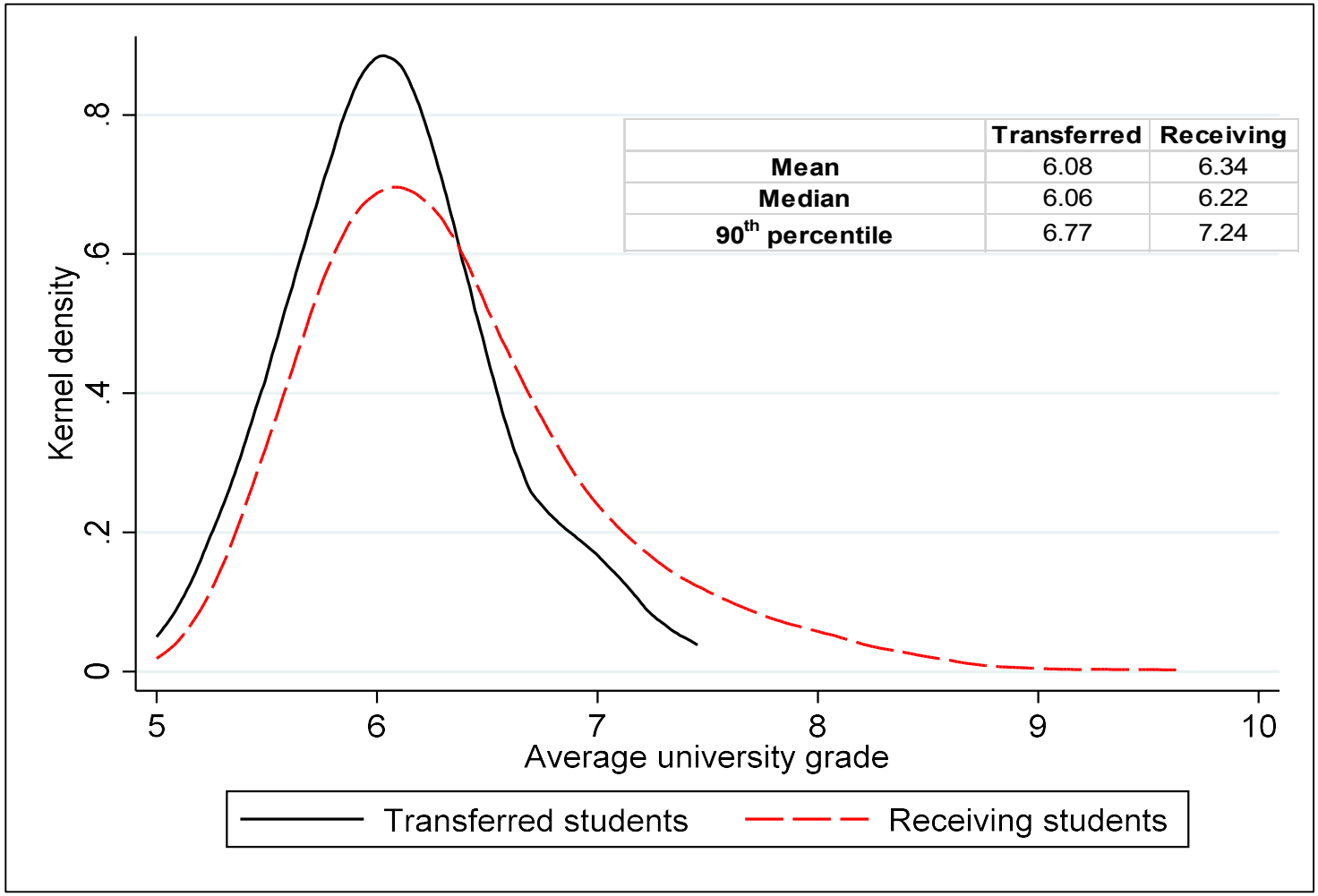
Notes: The left panel shows the kernel density of school grades of transferred and receiving students. The right panel depicts box plots of school grades by enrollement type. The line inside each box depicts the median, while the edges of the box correspond to the 75th percentile (upper hinge) and 25th percentile (lower hinge). The adjucent lines of the figures correspont to the 90th percentile (upper adjacent value) and the 10th percentile (lower adjacent value). Outlier values are excluded.

FIGURE 4. STANDARDIZED NATIONAL EXAMINATION GRADES BY ENROLLMENT TYPE



Notes: The left panel shows the kernel density of the standardized national examination grades of transferred and receiving students. The right panel shows box plots of the standardized national examination grades by enrollement type. The line inside each box depicts the median, while the edges of the box correspond to the 75th percentile (upper hinge) and 25th percentile (lower hinge). The adjucent lines of the figures correspont to the 90th percentile (upper adjacent value) and the 10th percentile (lower adjacent value). Outlier values are excluded.

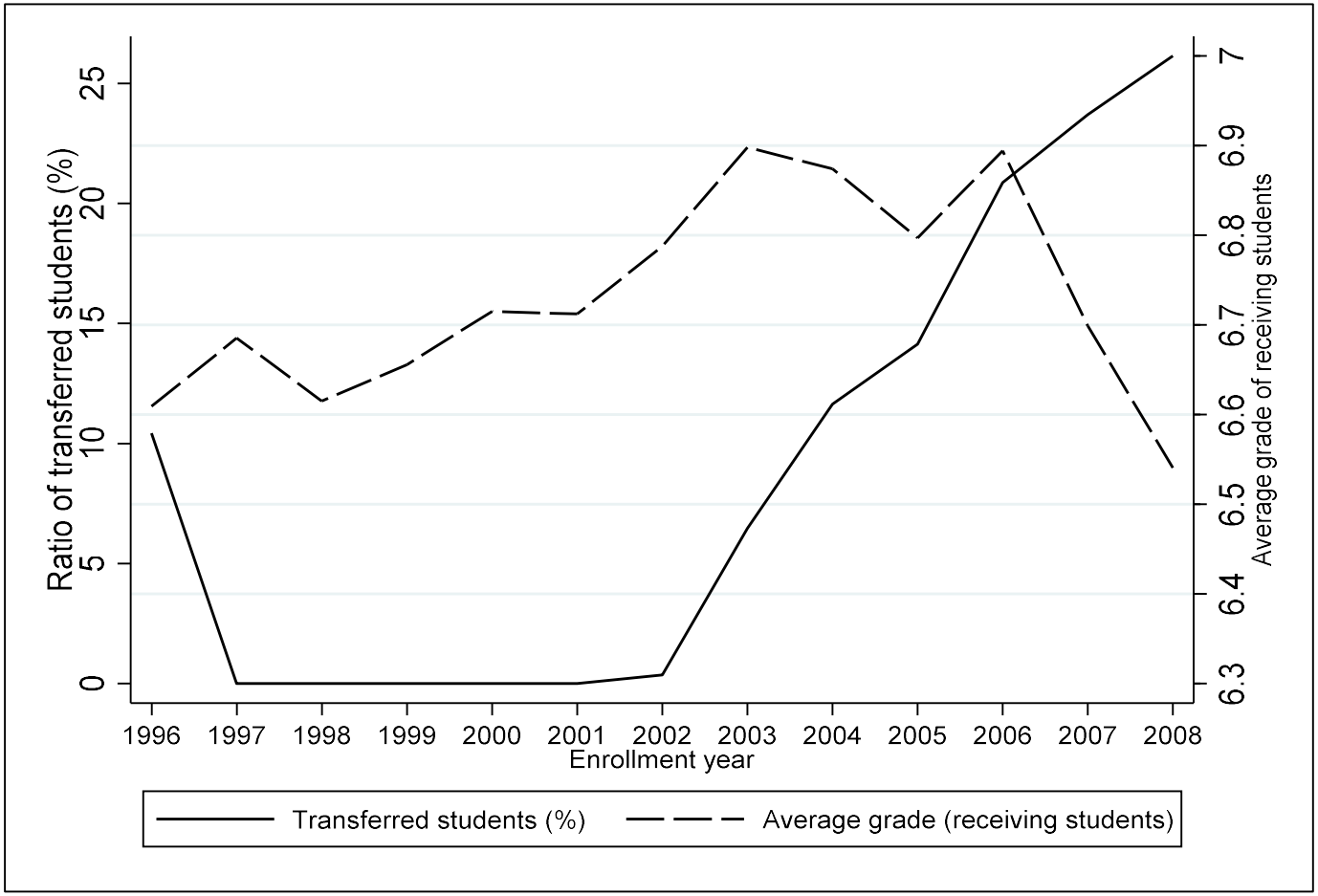
FIGURE 5. AVERAGE GRADE BY ENROLLMENT TYPE



	Transferred	Receiving
Mean	6.08	6.34
Median	6.06	6.22
90th percentile	6.77	7.24

Notes: The figure plots the kernel density of the average university grade by enrollment type. Table reports the mean, median and 90th percentile of the average university grade, by enrollment type.

FIGURE 6: PERCENTAGE OF TRANSFERRED STUDENTS AND AVERAGE GRADE OF RECEIVING STUDENTS



Notes: The figure plots the average university grade of receiving students (dotted line) and the ratio of transferred students, defined as the percentage of transferred students over the total number of students (continuous line).

TABLE 1 - GRADUATION RATE BY ENROLLMENT TYPE

	(1)	(2)	(3)
Enrollment type	Students composition at entry (%)	Graduated in four years (%)	Not graduated in four years (%)
Receiving	77	85	63
Transferred	8	6	23
Others	15	9	14

Note: Column one reports the composition at entry, by enrollement type (N=2692). Column 2 shows the percentage of students who graduated in 4 years. Column 3 shows the percentage of students who completed 4 years of studies but did not graduate.

TABLE 2 - SUMMARY STATISTICS

Variable	Receiving	Transferred	Difference test
Demographics			
Female	0.547	0.626	-0.078**
	(0.498)	(0.485)	(0.023)
Parents' residence in the same city	0.644	0.617	0.033
	(0.479)	(0.487)	(0.414)
Private school	0.147	0.066	0.081***
	(0.354)	(0.249)	(0.001)
Before university entry			
School grade	18.025	16.961	1.063***
	(1.007)	(1.289)	(0.000)
Panhellenic exam score	88.299	80.254	8.046***
	(2.934)	(4.329)	(0.000)
Ranking order	102.592	-	
	(62.692)		
Preference order	3.929	-	
	(4.003)		
Classics major	0.092	0.062	0.031
	(0.290)	(0.241)	(0.121)
University academic performance			
Number of years	4.533	4.313	0.221**
	(1.489)	(1.169)	(0.030)
Average grade (core modules)	6.340	6.079	0.261***
	(0.653)	(0.453)	(0.000)
Observations	2,379	227	

Notes: Columns 1 and 2 report means for receiving and transferred students (standard deviations provided in parenthesis). Column 3 shows the difference together with a two-sample t-test on the equality of means (p-values provided in parenthesis): *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 3 - TRANSFERRED STUDENTS IMPACT ON RECEIVING STUDENTS (AGGREGATE LEVEL)

Dependent variable	(1) $Grade_{ct}$	(2) $Grade_{ct}$	(3) $Grade_{ct}$	(4) $Grade_{ct}$	(5) $Pass_{ct}$	(6) $Pass_{ct}$	(7) $Pass_{ct}$	(8) $Pass_{ct}$
$Transfer\_Fraction_{ct}$	-0.447***		-0.448***		-0.103***		-0.103***	
	(0.112)		(0.110)		(0.024)		(0.024)	
$First\_quartile\_Transfer\_fraction_{ct}$		-0.370**		-0.322*		-0.068**		-0.064**
		(0.175)		(0.165)		(0.029)		(0.030)
$Second\_quartile\_Transfer\_fraction_{ct}$		-0.696***		-0.672***		-0.130***		-0.128***
		(0.219)		(0.206)		(0.037)		(0.037)
$Third\_quartile\_Transfer\_fraction_{ct}$		-1.015***		-0.994***		-0.205***		-0.203***
		(0.248)		(0.237)		(0.042)		(0.041)
$Fourth\_quartile\_Transfer\_fraction_{ct}$		-1.065***		-1.033***		-0.237***		-0.234***
		(0.287)		(0.289)		(0.056)		(0.056)
$Total\_number\_of\_students_{ct}$			-0.143	-0.114			-0.016	-0.010
			(0.087)	(0.082)			(0.013)	(0.012)
Observations	522	522	522	522	522	522	522	522
Within R-squared	0.402	0.421	0.408	0.425	0.393	0.409	0.395	0.410
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is the average academic outcome ($Grade_{ct}$ or $Pass_{ct}$) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Transfer\_Fraction_{ct}$ is the ratio of transferred students over the total number of students taking course c at examination period t, $Course_c$ are course fixed effects and $Exam\_Period_t$ are joint year-examination period fixed effects. $Fourth\_quartile\_Transfer\_Fraction_{ct}$ is the highest quartile of the fraction of trasferred students and $Total\_number\_of\_students_{ct}$ is the total number of students in course c at examination period t. Each year there are three examination periods in February, July and September. Standard errors, clustered at the course level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 4 - TRANSFERRED STUDENTS IMPACT ON RECEIVING STUDENTS (VALUE ADDED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$
Sample	Benchmark	Characteristics	Female	Male	Bottom quartile	2^{nd} quartile	3^{rd} quartile	Top quartile
$Transfer\_fraction_{ct}$	-0.087**	-0.078**	-0.070*	-0.089**	-0.096**	-0.086**	-0.074*	-0.053
	(0.041)	(0.037)	(0.039)	(0.038)	(0.039)	(0.041)	(0.043)	(0.042)
$GPA_{i(t-1)}$ university average up to that exam period	0.432***	0.368***	0.371***	0.364***	0.343***	0.381***	0.369***	0.369***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)	(0.010)	(0.010)	(0.009)
Observations	71,614	71,614	38,421	33,193	18,675	18,143	17,991	16,697
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes	yes	yes	yes
Additional controls: gender, private school, classics major, family town, preference order, school grade, ranking order, experience.		yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is the academic outcome ($Grade_{ict}$) obtained by receiving student *i* (who has entered through panhellenic exams) in course c at examination period t (joint year-examination semester) and ranges from 0 to 10. $Transfer\_Fraction_{ct}$ is the ration of transferred students divided by the total number of students taking course c at examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. The additional characteristics include indicators for gender, private high school graduate, whether the student majored in mathematics at high school, whether the family residence is in the same city as the university, whether that department was the student's first choice, the student's high school average grade, indicator variables based on the ranking order upon entering the university and an indicator of whether this is the first time taking exams for this course. Full results reported in the Appendix (Table A2). Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 5 - TRANSFERRED STUDENTS IMPACT ON RECEIVING STUDENTS (VALUE ADDED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Sample	benchmark	characteristics	Female	Male	Bottom quartile	2nd quartile	3rd quartile	Top quartile
$Transfer\_fraction_{ct}$	-0.050***	-0.044*	-0.045***	-0.044***	-0.053***	-0.054***	-0.044**	-0.025
	(0.018)	(0.022)	(0.016)	(0.016)	(0.018)	(0.018)	(0.019)	(0.018)
$GPA_{i(t-1)}$ university average up to that exam period	0.166***	0.130***	0.133***	0.127***	0.125***	0.139***	0.136***	0.116***
	(0.003)	(0.007)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	71,614	71,614	38,421	33,193	18,675	18,143	17,991	16,697
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes	yes	yes	yes
Additional controls: gender, private school, classics major, family town, preference order, school grade, ranking order, experience.		yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is is the academic outcome ($Pass_{ict}$) obtained by incumbent student i (who has entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Pass_{ict}$ is an indicator variable that takes the value one if the grade achieved was above or equal to 5/10. $Transfer\_Fraction_{ct}$ is the ratio of transferred students over the total number of students taking course c at examination period t. $GPA_{i(t-1)}$ (grade point average) is student i's average university grade up to that examination period. $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. The additional characteristics include indicators for gender, private high school graduate, whether the student majored in mathematics at high school, whether the family residence is in the same city as the university, whether that department was the student's first choice, the student's high school average grade, indicator variables based on the ranking order upon entering the university and an indicator of whether this is the first time the student is taking exams for this course. Full table reported in the Appendix (A3). All regressions were estimated using a linear probability model. Table A4 reports similar estimates from a logit model. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 6 - PEER EFFECTS IN ACHIEVEMENT FOR RECEIVING STUDENTS

	(1)	(2)	(3)	(4)
Estimation method	2SLS	2SLS	2SLS	2SLS
Dependent variable	$Grade_{ict}$	$Grade_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Sample	benchmark	with characteristics	benchmark	with characteristics
$\overline{y}_{-ict}$	0.272***	0.239***	0.107***	0.091***
average peer score	(0.049)	(0.059)	(0.016)	(0.017)
$GPA_{i(t-1)}$	0.431***	0.372***	0.166***	0.131***
university average up to that exam period	(0.007)	(0.007)	(0.003)	(0.003)
First Stage				
$Transfer\_fraction_{ct}$	-0.328***	-0.282**	-0.462***	-0.399***
	(0.108)	(0.109)	(0.109)	(0.108)
F-test of excluded instruments	9.21	6.72	17.98	13.59
p-value	[0.003]	[0.010]	[0.000]	[0.000]
Observations	71,606	71,606	71,606	71,606
$Exam\_Period_t$	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes
Additional controls: gender, private school, theoretical major, family town, preference order, school grade, ranking order, experience.		yes		yes

Notes: Estimated results based on equation 3 in the main text. The dependent variable is the academic outcome ($Grade_{ict}$ or $Pass_{ict}$) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Transfer\_Fraction_{ct}$ is the ratio of transferred students divided by the total number of students taking course c at examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. The additional characteristics include indicators for gender, private high school graduate, whether the student majored in mathematics at high school,whether the family residence is in the same city as the university, whether that department was the student's first choice, the student's high school average grade, indicator variables based on the ranking order upon entering the university and an indicator of whether this is the first time taking exams for this course. Full table reported in the Appendix (A5). Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 7 - NON-LINEAR PEER EFFECTS FOR RECEIVING STUDENTS

	(1)	(2)	(3)	(4)
Estimation method	2SLS	2SLS	2SLS	2SLS
Dependent variable	$Grade_{ict}$	$Grade_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Sample	benchmark	with characteristics	benchmark	with characteristics
Average peer grade × quartile 1 of receiving student distribution	0.182	0.127	0.146**	0.113
	(0.136)	(0.156)	(0.067)	(0.073)
Average peer grade × quartile 2 of receiving student distribution	0.282***	0.288**	0.096*	0.090
	(0.106)	(0.121)	(0.058)	(0.058)
Average peer grade × quartile 3 of receiving student distribution	0.208*	0.170	0.035	0.018
	(0.118)	(0.126)	(0.079)	(0.085)
Average peer grade × quartile 4 of receiving student distribution	0.409***	0.371**	0.146**	0.141*
	(0.149)	(0.146)	(0.065)	(0.074)
$GPA_{i(t-1)}$ university average up to that exam period	0.430***	0.370***	0.166***	0.131***
	(0.007)	(0.007)	(0.003)	(0.003)
Observations	71,498	71,498	71,498	71,498
$Exam\_Period_t$	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes
Additional controls: gender, private school, theoretical major, family town, preference order, school grade, ranking order, experience.		yes		yes

Notes: Estimated results based on equation 4 in the main text. The dependent variable is the academic outcome ($Grade_{ict}$ or $Pass_{ict}$) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester). *Quartile 4 of receiving student distribution* is the highest quartile of the receiving students in terms of quality , based on the standardized national examination grades. The instruments used are the interactions of the fraction of transferred students with the receiving students' quartile. $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. The additional characteristics include indicators for gender, private high school graduate, whether the family residence is in the same city as the university, whether that department was the student's first choice, whether the student majored in mathematics at high school, the student's high school average grade, indicator variables based on the ranking order upon entering the university and an indicator of whether this is the first time taking exams for this course. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 8 - FULLY NON-LINEAR PEER EFFECTS FOR RECEIVING STUDENTS

Panel A

	(1)	(2)	(3)	(4)	(5)
Dependent variable	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$
Period	ALL	Bottom quartile	2nd quartile	3rd quartile	Top quartile
$Transfer\_fraction_{ct}$ in bottom quartile	-0.064	-0.092**	-0.071	-0.046	-0.033
	(0.040)	(0.042)	(0.043)	(0.044)	(0.049)
$Transfer\_fraction_{ct}$ in quartile 2	-0.005	0.017	-0.014	-0.022	-0.026
	(0.031)	(0.036)	(0.035)	(0.036)	(0.032)
$Transfer\_fraction_{ct}$ in quartile 3	-0.038	-0.027	-0.039	-0.023	-0.064
	(0.036)	(0.037)	(0.040)	(0.038)	(0.043)
$Transfer\_fraction_{ct}$ in top quartile	-0.017	-0.016	-0.015	-0.023	-0.038
	(0.026)	(0.027)	(0.029)	(0.028)	(0.031)
Observations	79,923	21,878	20,785	19,381	17,879
$Exam\_Period_t$	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes

Panel B

Dependent variable	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Period	ALL	Bottom quartile	2nd quartile	3rd quartile	Top quartile
$Transfer\_fraction_{ct}$ in bottom quartile	-0.035**	-0.054***	-0.031	-0.034*	-0.013
	(0.018)	(0.019)	(0.020)	(0.021)	(0.021)
$Transfer\_fraction_{ct}$ in quartile 2	-0.017	-0.010	-0.022	-0.017	-0.028**
	(0.013)	(0.017)	(0.016)	(0.016)	(0.012)
$Transfer\_fraction_{ct}$ in quartile 3	-0.013	-0.003	-0.019	-0.007	-0.027
	(0.015)	(0.016)	(0.017)	(0.017)	(0.017)
$Transfer\_fraction_{ct}$ in top quartile	-0.005	-0.003	-0.008	-0.008	-0.009
	(0.011)	(0.013)	(0.013)	(0.012)	(0.013)
Observations	79,923	21,878	20,785	19,381	17,879
$Exam\_Period_t$	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes

Notes: Estimated results based on equation 5 in the main text. The dependent variable is the academic outcome ($Grade_{ict}$ or $Pass_{ict}$) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. Quartiles are based on the students' pre-university achievements (standardized national examination grades). All regressions were estimated using OLS. Standard errors, clustered at the course-period level. are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 9 - PEER EFFECT HETEROGENEITY ACROSS COURSE TYPE

	(1)	(2)	(3)	(4)
Estimation method	2SLS	2SLS	2SLS	2SLS
Dependent variable	$Grade_{ict}$	$Grade_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Sample	econ	math	econ	math
$\overline{y}_{-ict}$	0.129	0.306***	0.066*	0.130***
average peer score	(0.233)	(0.040)	(0.037)	(0.017)
$GPA_{i(t-1)}$	0.439***	0.408***	0.167***	0.162***
university average up to that exam period	(0.008)	(0.013)	(0.003)	(0.005)
First Stage				
$Transfer\_fraction_{ct}$	-0.127	-0.548***	-0.320***	-0.564***
	(0.116)	(0.165)	(0.118)	(0.175)
F-test of excluded instruments	1.20	11.05	7.33	10.36
p-value	[0.275]	[0.001]	[0.007]	[0.002]
Observations	52,551	19,055	52,551	19,055
$Exam\_Period_t$	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes

Notes: Estimated results based on equation 3 in the main text. Math refers to courses with a stronger mathematics component, such as mathematics, statistics and econometrics, whereas econ refers to all other courses (see section 4.3 in the main text). The dependent variable is the academic outcome ($Grade_{ict}$ or $Pass_{ict}$) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Transfer\_Fraction_{ct}$ is the ratio of transferred students over the total number of students taking course c at examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE A1 - RANDOM ASSIGNMENT

Dependent variable	(1) National exam grade	(2) Female	(3) Private school	(4) Family same city	(5) Ranking order	(6) School grade	(7) Classics major
$Transfer\_indicator_{ct}$	-124.808	-0.007	-0.009*	0.004	-0.534	-0.031*	0.001
(D = 1 when there are transferred students in class)	(76.820)	(0.008)	(0.005)	(0.008)	(1.065)	(0.016)	(0.004)
Observations	41,617	41,617	41,617	41,617	41,583	27,300	41,617
Within R-squared	0.856	0.0136	0.0295	0.0114	0.0434	0.536	0.0600
$Enrollment\ Year_t$	yes	yes	yes	yes	yes	yes	yes
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes

Notes: In this table we regress each pre-determined characteristic of the receiving student population on an indicator variable that is one if transferred students were present in that particular class and year-examination period.The dependent variable is: in column 1 the grade achieved in the national (panhellenic examination) univerity entry exams, in column 2 a female indicator variable, in column 3 an indicator of whether the student went to private school, in column 4 an indicator of whether the family's residence is in the same city as the university, in column 5 the ranking order upon entering the university, in column 6 the student's high school average grade and in column 7 whether the student majored not in mathematics at high school. $Transfer\_Indicator_{ct}$ is binary indicator that equals one when transferred students were present in that course c and examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE A2 - TRANSFERRED STUDENTS IMPACT ON RECEIVING STUDENTS (VALUE ADDED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Dependent variable	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$	$Grade_{ict}$
Sample	Benchmark	Characteristics	Female	Male	Bottom quartile	2nd quartile	3rd quartile	Top quartile
$Transfer\_fraction_{ct}$	-0.087**	-0.078**	-0.070*	-0.089**	-0.096**	-0.086**	-0.074*	-0.053
	(0.041)	(0.037)	(0.039)	(0.038)	(0.039)	(0.041)	(0.043)	(0.042)
$GPA_{i(t-1)}$	0.432***	0.368***	0.371***	0.364***	0.343***	0.381***	0.369***	0.369***
university average up to that exam period	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)	(0.010)	(0.010)	(0.009)
Female		0.020***			0.025*	0.003	0.049***	0.018
		(0.007)			(0.014)	(0.014)	(0.014)	(0.015)
Private school		0.024**	0.033**	0.016	0.042**	0.012	-0.004	0.015
		(0.010)	(0.014)	(0.014)	(0.021)	(0.018)	(0.020)	(0.019)
Parents' residence in the same city		-0.013*	-0.015	-0.007	-0.025*	0.002	-0.015	0.003
		(0.007)	(0.010)	(0.011)	(0.013)	(0.013)	(0.014)	(0.016)
High school specialization without maths		-0.037**	-0.054***	-0.016	-0.041	-0.075***	0.010	-0.058**
		(0.015)	(0.016)	(0.028)	(0.026)	(0.024)	(0.024)	(0.027)
Dept first in preference		0.017*	0.046***	-0.012	0.020	-0.010	-0.001	0.036**
		(0.010)	(0.013)	(0.014)	(0.024)	(0.019)	(0.018)	(0.015)
School grade		0.005	0.015**	0.001	-0.001	0.021***	0.001	-0.007
		(0.004)	(0.006)	(0.005)	(0.007)	(0.008)	(0.008)	(0.009)
Top 10 panhellenic student		0.106***	0.084***	0.128***	0.004	0.154**		-0.092
		(0.023)	(0.029)	(0.032)	(0.055)	(0.069)		(0.182)
Top10-50 panhellenic student		0.024	-0.001	0.052**	0.036	-0.070*	0.053	-0.169
		(0.016)	(0.021)	(0.025)	(0.051)	(0.038)	(0.174)	(0.180)
Top50-100 panhellenic student		0.013	0.021	0.004	0.050	-0.058	0.223	-0.176
		(0.015)	(0.020)	(0.023)	(0.065)	(0.038)	(0.164)	(0.181)
Top100-200 panhellenic student		0.003	0.013	-0.003	-0.034		0.235	
		(0.014)	(0.019)	(0.023)	(0.022)		(0.164)	
First time taking this course		0.502***	0.484***	0.520***	0.489***	0.482***	0.485***	0.551***
		(0.015)	(0.016)	(0.016)	(0.019)	(0.018)	(0.018)	(0.020)
Observations	71,614	71,614	38,421	33,193	18,675	18,143	17,991	16,697
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is the academic outcome ($Grade_{ict}$) obtained by receiving student *i* (who has entered through panhellenic exams) in course c at examination period t (joint year-examination semester) and ranges from 0 to 10. $Transfer\_Fraction_{ct}$ is the ratio of transferred students overthe total number of students taking course c at examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. $GPA_{i(t-1)}$(grade point average) is student *i*'s average university grade up to that examination period. *Female* is an indicator variable that takes the value 1 if the student is female, *private school* is an indicator variable that takes the value 1 if the student graduated from a private school, *Parents' residence in the same city* is an indicator that equals 1 if the family's residence is in the same city as the university, *High school specialization without maths* is an indicator that equals 1 if the student majored in classics at school, *Dept first in preference* is an indicator that equals 1 if the department was the student's first choice and school grade is the student's average school grade. *Top 10 panhellenic student* equals 1 if the student ranked in the top 10, based on the grades they achieved in the national (panhellenic examination) univerity entry exams. *First time taking this course*, equals 1 if this is the first time the student is taking an exam for this course. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE A3 - TRANSFERRED STUDENTS IMPACT ON RECEIVING STUDENTS (VALUE ADDED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Dependent variable	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Sample	benchmark	characteristics	Female	Male	Bottom quartile	2nd quartile	3rd quartile	Top quartile
$Transfer\_fraction_{ct}$	-0.050***	-0.044*	-0.045***	-0.044***	-0.053***	-0.054***	-0.044**	-0.025
	(0.018)	(0.022)	(0.016)	(0.016)	(0.018)	(0.018)	(0.019)	(0.018)
$GPA_{i(t-1)}$	0.166***	0.130***	0.133***	0.127***	0.125***	0.139***	0.136***	0.116***
	(0.003)	(0.007)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Gender		0.003			0.007	-0.007	0.012	0.003
		(0.005)			(0.007)	(0.007)	(0.007)	(0.007)
Private school		0.011*	0.016**	0.006	0.022**	-0.002	0.001	0.014
		(0.006)	(0.007)	(0.007)	(0.011)	(0.010)	(0.010)	(0.010)
Parents' residence in the same city		-0.008*	-0.013***	-0.001	-0.013*	0.000	-0.011	0.001
		(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.008)
High school specialization without maths		-0.012	-0.015*	-0.015	0.001	-0.042***	0.000	-0.009
		(0.012)	(0.008)	(0.014)	(0.013)	(0.013)	(0.012)	(0.012)
Dept first in preference		0.004	0.009	0.000	-0.000	-0.012	-0.006	0.019**
		(0.004)	(0.006)	(0.007)	(0.012)	(0.010)	(0.010)	(0.008)
School grade		0.003	0.008**	0.001	-0.000	0.010**	0.001	0.001
standardized school grade		(0.003)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.005)
Top 10 panhellenic student		0.014	0.011	0.013	-0.002	0.064		-0.119
		(0.008)	(0.015)	(0.017)	(0.026)	(0.039)		(0.086)
Top10-50 panhellenic student		0.007	0.000	0.013	0.013	-0.068***	-0.004	-0.119
		(0.005)	(0.011)	(0.013)	(0.024)	(0.020)	(0.101)	(0.085)
Top50-100 panhellenic student		0.008	0.015	0.000	0.030	-0.035*	0.050	-0.129
		(0.005)	(0.011)	(0.013)	(0.032)	(0.020)	(0.097)	(0.085)
Top100-200 panhellenic student		0.004	0.009	-0.001	-0.012		0.047	
		(0.006)	(0.011)	(0.012)	(0.012)		(0.097)	
First time taking this course		0.313***	0.306***	0.319***	0.307***	0.305***	0.303***	0.334***
		(0.013)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Observations	71,614	71,614	38,421	33,193	18,675	18,143	17,991	16,697
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is is the academic outcome ($Pass_{ict}$) obtained by incumbent student *i* (who has entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Pass_{ict}$ is an indicator variable that takes the value one if the grade achieved was above or equal to 5/10. $Transfer\_Fraction_{ct}$ is the ratio of transferred students over the total number of students taking course c at examination period t. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. *Female* is an indicator variable that takes the value 1 if the student is female, *private school* is an indicator variable that takes the value 1 if the student graduated from a private school, *Parents' residence in the same city* is an indicator that equals 1 if the family's residence is in the same city as the university, *High school specialization without maths* is an indicator that equals 1 if the student majored in classics at school, *Dept first in preference* is an indicator that equals 1 if the department was the student's first choice and school grade is the student's average school grade. *Top 10 panhellenic student* equals 1 if the student ranked in the top 10, based on the grades they achieved in the national (panhellenic examination) univerity entry exams. *First time taking this course*, equals 1 if this is the first time the student is taking an exam for this course. $Course_c$ are course fixed effects and $Exam\_Period_t$ are joint year-examination period fixed effects. All regressions were estimated using a linear probability model. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE A4 - TRANSFERRED STUDENTS IMPACT ON RECEIVING STUDENTS (VALUE ADDED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Dependent variable	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$	$Pass_{ict}$
Sample	benchmark	characteristics	Female	Male	Bottom quartile	2nd quartile	3rd quartile	Top quartile
$Transfer\_fraction_{ct}$	-0.245***	-0.244**	-0.246***	-0.242***	-0.275***	-0.287***	-0.242**	-0.156
	(0.084)	(0.117)	(0.085)	(0.084)	(0.091)	(0.094)	(0.098)	(0.098)
$GPA_{i(t-1)}$	0.797***	0.693***	0.713***	0.675***	0.642***	0.739***	0.720***	0.673***
university average up to that exam period	(0.015)	(0.033)	(0.019)	(0.019)	(0.024)	(0.025)	(0.025)	(0.024)
Observations	71,614	71,614	38,421	33,193	18,675	18,143	17,991	16,697
$Exam\_Period_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes	yes	yes	yes	yes
Additional controls: gender, private school, classics major, family town, preference order, school grade, ranking order, experience.		yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is is the academic outcome ($Pass_{ict}$) obtained by incumbent student i (who has entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Pass_{ict}$ is an indicator variable that takes the value one if the grade achieved was above or equal to 5/10. $Transfer\_Fraction_{ct}$ is the ratio of transferred students over the total number of students taking course c at examination period t. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. $Course_c$ are course fixed effects and $Exam\_Period_t$ are joint year-examination period fixed effects. The additional characteristics include indicators for gender, private high school graduate, whether the family residence is in the same city as the university, whether that department was the student's first choice, whether the student majored in mathematics at high school, and the student's high school average grade, ranking order upon entering the university based on the national examinations and an indicator of whether this is the first time taking exams for this course. All regressions were estimated using a logit probability model. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE A5 - PEER EFFECTS IN ACHIEVEMENT FOR RECEIVING STUDENTS

Dependent variable Sample	(1) Grade benchmark	(2) Grade with characteristics	(3) Pass benchmark	(4) Pass with characteristics
$\overline{y}_{-ict}$ average peer grade	0.272*** (0.049)	0.239*** (0.059)	0.107*** (0.016)	0.091*** (0.017)
$GPA_{i(t-1)}$ university average up to that exam period	0.431*** (0.007)	0.372*** (0.007)	0.166*** (0.003)	0.131*** (0.003)
Total number of students		0.013 (0.017)		0.009 (0.007)
Female		0.020*** (0.007)		0.003 (0.004)
Private school		0.025** (0.010)		0.011** (0.005)
Parents' residence in the same city		-0.013* (0.007)		-0.007** (0.004)
High school specialization without maths		-0.040*** (0.015)		-0.014* (0.007)
Dept first in preference		0.019* (0.010)		0.004 (0.005)
School grade standardized school grade		0.006 (0.004)		0.004* (0.002)
Top 10 panhellenic student		0.102*** (0.022)		0.012 (0.011)
Top10-50 panhellenic student		0.022 (0.015)		0.007 (0.008)
Top50-100 panhellenic student		0.014 (0.014)		0.008 (0.008)
Top100-200 panhellenic student		0.002 (0.014)		0.004 (0.008)
First time taking this course		0.464*** (0.017)		0.298*** (0.008)
Observations	71,606	71,606	71,606	71,606
$Exam\_Period_t$	yes	yes	yes	yes
$Enrollment\_Year_t$	yes	yes	yes	yes
$Course_c$	yes	yes	yes	yes

Notes: Estimated results based on equation 3 in the main text. The dependent variable is the academic outcome ($Grade_{ict}$ or $Pass_{ict}$) obtained by receiving students (who have entered through panhellenic exams) in course c at examination period t (joint year-examination semester). $Transfer\_Fraction_{ct}$ is the ratio of transferred students over the total number of students taking course c at examination period t, $Course_c$ are course fixed effects, $Exam\_Period_t$ are joint year-examination period fixed effects and $Enrollment\_Year_t$ are year fixed effects based on the enrollment year of each student. $GPA_{i(t-1)}$(grade point average) is student i's average university grade up to that examination period. *Female* is an indicator variable that takes the value 1 if the student is female, *private school* is an indicator variable that takes the value 1 if the student graduated from a private school, *Parents' residence in the same city* is an indicator that equals 1 if the family's residence is in the same city as the university, *High school specialization without maths* is an indicator that equals 1 if the student majored in classics at school, *Dept first in preference* is an indicator that equals 1 if the department was the student's first choice and school grade is the student's average school grade. *Top 10 panhellenic student* equals 1 if the student ranked in the top 10, based on the grades they achieved in the national (panhellenic examination) univerity entry exams. *First time taking this course*, equals 1 if this is the first time the student is taking an exam for this course. Standard errors, clustered at the course-period level, are reported in parentheses below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

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