# Can Conditional Grants Attract Better Students: Evidence from Chinese Normal Universities.

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## Abstract

One recent policy direction to improve teacher quality is to provide conditional grants to trainees in teacher colleges and commit them to working in disadvantaged areas upon graduation. Yet little is known whether such policies can attract better trainees. This paper evaluates a conditional grant program for teaching majors in Chinese normal universities, which commits students to teaching in their home province. By exploiting both within- and across-university comparison, we find that the program increased the overall entry scores of students in teaching majors relative to regular majors. However, much of the positive effect arises in the high- and middle-income regions while high-performing students from low-income regions tend to turn away from teaching majors. Further analysis suggests that a possible reason is that students are unwilling to commit to returning to their poor hometown.

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# 1 Introduction

Teacher quality has generally been believed to be a key factor for improving students' learning outcomes (Hanushek 2009). Yet policies on improving teacher quality often fail to deliver the expected outcomes when other forces are at play. Low-income and disadvantaged areas often lose their potential pool of good teachers to other economically advanced areas; also in areas where the private sector has fast development, the teaching profession sometimes suffers from "a brain drain," i.e., high-quality teachers are driven out of this profession by attractive outside options (Lakdawalla 2006; Bacolod 2007). A variety of measures have been taken by governments in some countries to address this issue. A new direction of public policies is to provide conditional grants for trainees in teacher colleges and commit them to working in disadvantaged regions. One recent example in developed countries is the Teacher Education Assistance for College and Higher Education (TEACH) grant program passed by American congress in 2007, which provides grants of up to $4,000 per year to students who intend to teach in a public or private elementary or secondary school that serves students from low-income families. Developing countries have also been experimenting with such programs. Among other countries, the Chinese Ministry of Education announced a huge conditional grant program for the six top national teacher colleges in 2007, which waives all tuitions and fees of students in teaching majors but requires them to teach in their home province for ten years upon graduation. Can this program improve the quality of incoming teacher trainees? This is the question that this paper attempts to address.

Despite much policy interest, the effect of such programs is theoretically ambiguous and empirically unexplored. On the one hand, financial aids may induce more enrollments by reducing the net price. On the other hand, the associated career constraints may reduce future returns of participating students and drive away the high-performing students. The same tradeoff between enjoying immediate price cut and avoiding future locked-in also exists in many similar conditional grant programs in other settings. For example,

some state governments in the United States provide more subsidies for students who choose in-state public colleges instead of private ones or colleges in other states, i.e., the Cal Grant, the District of Columbia Tuition Assistance Grant (DCTAG), and Tennessee Education Lottery Scholarships (TELS). The recent effort to identify the price effect on enrollment by exploiting the exogenous policy changes generally find that reducing the net price tends to increase the overall college enrollment rate of the targeted students (e.g., Dynarski, 2000; Kane, 2003; Cornwell et al., 2006; Abraham and Clark, 2006; Monks, 2008; Linsenmeier, Rosen and Rouse, 2006). Yet, the evidences on the effect of merit aid programs on college choices are less unanimous. For instance, Abraham and Clark (2006) find no evidence that DCTAG Program led students who would otherwise attend more selective colleges to attend less selective schools eligible for the grant; Pallais (2009) finds that TELS program did not induce more students to stay in in-state colleges. On the contrary, Avery and Hoxby (2004) do find that the high-aptitude students in their survey generally make rational decisions in face of the trade-off between net price and perceived quality of college education. Moreover, little has been said in the previous literature about how the supply of college slots would affect the final enrollment outcome. An exception is that Kane (2003) use Cal Grant to minimize impact from supply side. Yet he could not rule out the explanation that the effect results from the adjustment of the admission policies in program colleges.

The settings in Chinese normal universities is useful to examine how such conditional grant program influences students' college choices. First, normal universities in China are typically offering universal majors including both teaching majors and non-teaching majors. The program only applies to students in teaching majors, which make non-teaching majors a useful comparison group. Second, given the huge regional income inequality, this grant program creates exogenous regional variations in recipients' expected returns by imposing an across-the-board condition. Specifically, participating students are eligible for tuition waive but are required to teach in their home provinces for ten years upon graduation. Lastly, the enrollment quota in each major for applicants from each

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province is set by the Ministry of Education before the application process. This enables us to directly control for the change in college supply and examine the student demand without assuming a perfectly elastic supply curve as in previous studies.

We first use the difference-in-differences (DID) approach to identify the program effect on the quality of incoming students. Since the conditional grant program only applies to students in teaching majors in six top national normal universities, we consider these teaching majors as the treatment group and non-teaching majors as the comparison group. We thus can estimate the program effect by comparing the change in the entry scores for teaching majors compared to that for non-teaching majors. Next we use other elite normal universities as an additional comparison group and employ the difference-in-differences-in-differences (DDD) method to further tease out the major-specific time trends.

The data used in this paper is the major-province-level enrollment information from 2005 to 2009. It contains information on the number of students in each major enrolled from each province and the corresponding mean, maximal, and minimal scores in the college entrance exams (CEE). Our main finding is that the overall scores have improved in teaching majors after the policy change compared to those in non-teaching majors. However, the positive effect is mainly from high- and middle-income regions, while the quality of students actually decreases in low-income regions.

The rest of this paper is organized as follows. Section 2 describes the institutional background and the conditional grant program. Section 3 provides a conceptual framework to illustrate the channels through which the effects are generated. Section 4 describes our data and empirical strategy. We report and interpret our main results in section 5 and also explore the channels. Section 6 concludes the paper.

# 2 Background

Lack of qualified teachers is a common problem plaguing the education system in many developing countries. China is no exception. The economically backward areas such as western regions and rural areas suffer even more as the fast economic development in eastern and middle regions has driven the talents from the west to the east, from the rural to the urban areas, and from the teaching profession to other professions. This problem has been exacerbated during the marketization reforms of the higher-education system. The national government therefore introduced the conditional tuition waive program in 2007 to guarantee the teacher force in the disadvantaged areas. In the following two subsections, we will first introduce the institutional background for teacher training in China and the introduction of the conditional grant program; then we will describe the college admission process because it is important for our empirical strategy.

## 2.1 Teacher training and conditional grant programs

The training of teachers usually begins at the college level in China. In particular, the teaching track is only available in certain majors of teacher colleges. Students in the teaching track are required to receive heavy pedagogical training besides that in their majored fields which are usually basic subjects like mathematics, physics, chemistry, biology, Chinese language, English, history, and geography.

Students in the teaching track were traditionally exempted from tuitions and enjoyed a sizable subsidy before the marketization reform in higher education. Upon graduation they would be posted through a mandatory allocation process. Both the pricing and the placement policy have changed since 1997 during the marketization reforms of higher education. The national government allowed teacher colleges to charge tuitions and various fees like other regular colleges; and the monthly subsidy for students in the teaching track is no more than 100 RMB. The government also called off the mandatory allocation of

graduates.[1] Without the advantage of low cost, teacher colleges were believed to have lost its attractiveness for eligible applicants with credit constraints. The quality of incoming trainees has declined. Meanwhile, it is also hard for economically backward regions to obtain qualified teacher trainees graduated from teacher colleges as the allocation is no longer mandatory.

To address this problem, the national government first implemented the conditional grant program in 2007 in six top national-level teacher colleges under the direct supervision of the Ministry of Education, including Beijing Normal University, Huazhong Normal University, Dongbei Normal University, Huazhong Normal University, Shaanxi Normal University and Xinan University.[2] Students who matriculate in the teaching majors in these six colleges will be exempted from tuition fees and accommodation during their four-year study. They can also obtain a monthly stipend of about 400 RMB.[3] In return, they will have to teach in an elementary school in their home province for ten years after graduation. Those who get a position in an urban school will first be assigned to teach in a rural school for two years. Pressured by the national government, some provincial governments such as Hebei, Sichuan, Xinjiang, Gansu, Shandong and so on have also begun to experiment with the same practice in the teacher colleges under their supervision since 2010.

This program has aroused much concerns as well as attention among practitioners and scholars. Some scholars applauding the policy believe that this grant program can attract talented students of relatively poor background into the teaching profession and improve the quality of future teaching force, while others worry that knowing that they would be locked in certain area for ten years is enough to scare the high-performing students away

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[1]Students can find teaching jobs for themselves since 1997 and the state will assign teaching positions for those who fail to find their jobs.

[2]State Council [2007] No. 30.

[3]Compared to those who matriculate into the non-teaching majors, a student who is eligible for the conditional grant program would save at least $10,000$ *RMB* (about $1,500$ U.S. dollars in 2007 dollar) per year, which is roughly the average annual income of a rural household with three people.

from the teaching track. Yet no study has systematically evaluated these programs.

## 2.2  College admission process

The college admission process in China can be described as a centralized matching process, in which the key criterion is the scores that a student get in the annual College Entrance Examinations (CEE).[4]

Colleges first draw up and publish an enrollment plan three months before the CEE, which specifies the number of slots allocated to each province at the major level. China has inherited from former Soviet Union a very fine categorization of majors.[5] Very often each major only admits one or two students from one province. This plan is subject to coordination and regulations of the Ministry of Education, who tries to balance the interests of colleges and provinces.

Each applicant needs to take the CEEs in the province where his/her *hukou* (household registration) is registered[6], and submit to the provincial admission office an application form in which a limited number of colleges and majors are listed in the order of preferences. Applicants can choose to enter the teaching track or remain in regular track. They cannot choose both in the application process or switch after the admission.

The matching between colleges/majors and students is conducted by the provincial admission offices, which have the full information on applicants' CEE scores and their preferences listed in the application form. First of all, the office sorts all colleges into three tiers, from the highest to the lowest-ranking colleges, and sets a cutoff score for each tier based on the total enrollment quota of colleges in each tier. That is, if one's

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[4]Only a very limited number of students can been directly recommended to a college without taking the CEE.

[5]For example, there can be hundreds of majors under the umbrella of "economics", with subtle variation in the names and no substantial difference in course materials.

[6]One's *hukou* place is usually the birthplace of his/her parents. It is very difficult to change the *hukou* place once granted.

score does not reach the cutoff line for the first tier, he/she can only be considered to match to a college in the second tier. The cutoff lines for each tier also differs between the teaching and regular tracks.

Next the provincial admission office will conduct the matching for majors and applicants in the teaching track.[7] After the matching for the teaching track is completed for all tiers of colleges, the admission office begins the matching for the regular track. The matching in both tracks is based on the CEE scores. For each college, the office ranks the applicants whose first choice is that college based on their CEE score and send the files of applicants from top to bottom to the relevant college. If the number of applicants is above the enrollment quota set by this college, the files of other applicants will be sent to their second-choice colleges.

In summary, the competition for college admission under the CEE system takes place within each province, as each major in each college has set enrollment quota each province and the admission is mainly based the ranking of applicants within the same province.

# 3    Conceptual Framework

In this section we adapt the simple two-stage model in Linsenmeier, Rosen, and Rouse (2006) to illustrate the channels through which the possible effects are generated and use it to guide our empirical analysis. First we analyze an individual student's choice between teaching major and non-teaching major. Then we zoom out to examine the equilibrium of an education market at province level.

At the individual level, suppose that typical student has the utility function $U = U(Y)$,

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[7]The matching for majors with additional enrollment requirement such as athletics, music, or painting and so on, is also conducted at the same time. We do not discuss it in details as the applicants for these majors are not in our analysis.

where $Y$ represents present value of income after graduation and $U'(Y) > 0$, $U''(Y) < 0$. We assume the expected income for a college graduate depends on their expected occupation. Before the policy change, students in either major enjoy the free career choice. After the policy change, normal students have to take a teaching position in their home province. For simplicity, assume that the expected income for a student with free career choice is $A$ and that for teacher in province $h$ is $T$. Also assume the college cost is $E_T$ and $E_A$ for teacher and non-teaching majors, respectively.

The student chooses to attend teaching majors if the expected net benefit, in expected utility terms, of attending teaching major over the alternative is positive. Before the policy change, the student attends teaching major if $\theta = U(E_A - E_T) > 0$. After the grant program took place, the student attends teaching major if $\theta = U(T - A + E_A) > 0$. Therefore, teaching majors become more attractive after the policy change if

$$\delta\theta = U(E_T + T - A) > 0, \tag{1}$$

that is, the college cost is larger than the expected utility loss from being locked in the teaching position.

In the market of higher education slots, a major's selectivity in each province is priced in terms of the incoming students' CEE scores. The determination of major-specific threshold can be explained by the standard demand-and-supply curve: The supply of a given major is generally predetermined and inelastic. Therefore the supply curve is a vertical line. As a major getting better, its threshold is rising and fewer students can afford it. Hence, we would observe a downward sloping demand curve. For simplicity, assume the equilibrium price for a single major is $P = D(\theta) - b \cdot Q, (b > 0)$, where $P$ is the score of the major and $Q$ is the supply of major slots.[8] $D(\theta)$ represents the intersect of the demand curve, which is a function of $\theta$ with $D'(\theta) > 0$ and $D''(\theta) < 0$.

To find the impact the grant program on the selectivity of teaching major, we first

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[8]If different teaching majors are substitutes for students, then Q should also include the enrollment of other teaching majors.

write the expected benefit of attending teaching major as the following form,

$$\theta = U(E_A - E_T) + g \cdot \delta\theta, \tag{2}$$

where $g$ is the indicator for the introduction of the grant program. Then we compute

$$\frac{\partial P}{\partial g} = D'(\theta) \cdot \delta\theta - b \cdot \delta Q, \tag{3}$$

Since $D'(\theta) > 0$ for all $\theta$, the sign of the first term depends on $\delta\theta$. If the net benefit of attending teaching major increases after the policy change, the student quality of teaching major will increase. The second term of equation (3) means the increase of supply, $\delta Q$, will decrease the student quality.

Therefore, if the expected benefit of attending teaching major decreases ($\delta\theta < 0$), the grant program decrease the quality of incoming student. By contrast, if the expected benefit increases ($\delta\theta > 0$), the policy effect on student quality is ambiguous.

Another question is whether some province would be more likely to have a positive policy effect than others, because the expected income of a normal student depends on the welfare level in her home province. The extent to which the grant becomes more attractive depends on

$$\frac{\partial^2 P}{\partial g \partial h} = [D''(\theta) \cdot g \cdot \delta\theta + D'(\theta)] \cdot U'(T) \cdot T'(h), \tag{4}$$

where $h$ is the welfare level of the student's home province and $g \cdot U'(T) \cdot T'(h) > 0$.

Therefore, if the expected benefit of attending teaching major decreases ($\delta\theta < 0$), the policy effect on student quality is negative but less negative in province with better welfare. By contrast, if the expected benefit increases ($\delta\theta > 0$), the magnitude of policy effect is ambiguous, which depends on the extent to which the responsiveness of student's choice to their expected utility diminishes as the utility increases.

# 4    Data and Empirical Strategy

## 4.1    Data

To examine the effect of the conditional grant program on student quality, we first compile a panel dataset on enrollment information from 2005 to 2009. The source of the data is The Guidelines for College Admissions (*Gao Kao Sheng Xue Tong*), a book series authorized by the Ministry of Education. This collection contains the annual enrollment information of each major in all Chinese college for all the 31 provinces, including the minimal, maximal and mean score as well as the number of students from each province admitted in each major. The exception is that no information is available for Zhejiang and Jiangsu in 2009. We also exclude Tibet and Xinjiang in our analysis because students from these two provinces may benefit from certain preferential admission policies. We focus on national level and good provincial level normal universities that are first-tier universities. Besides the six top normal universities eligible for the conditional grant program studied in this paper, we also include another 32 normal universities which we will use as comparison. The total number of observations in our sample is 29,383, with each observation being an admission record in each major for each province. We define a major as a teaching major if it is described as "will enroll normal students" in the enrollment plan provided by each college.

We also collect the data for provincial-level enrollment information including the total number of high school graduates, the total number of college applicants, the cutoff scores for the first- and second- tier colleges. This type of information is published by the provincial admission office annually.[9] In addition, we construct a provincial-level panel dataset on the socioeconomic characteristics including per capita GDP, social-welfare related fiscal expenditures, and the average wage in the education sector. The source of this data is from China Statistical Yearbooks 2005-2009 and China Fiscal Yearbooks.

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[9]An online dataset is available on the official CEE websites http://gaokao.chsi.com.cn/ and http://gkcx.eol.cn/.

## 4.2 Measurement and descriptive statistics

Since both the CEE and the admission process is administered at the province level, the raw scores of the CEE are not directly comparable across province and across year. Ideally we need to standardize the raw score based on the distribution of the scores in each province every year. However, the information on the mean and standard deviation of CEE scores is unavailable. Instead we construct a z-score type measure in the following way:

$$Y_{ijst} = \frac{score_{ijst} - cutoff^1_{st}}{cutoff^1_{st} - cutoff^2_{st}} \tag{5}$$

where $score_{ijst}$ is the raw score (mean or maximal scores) of students from province $s$ in major $i$ of college $j$ at time $t$; $cutoff^1_{st}$ and $cutoff^2_{st}$ are respectively the cutoffs for the first-tier colleges (*zhong dian gao xiao*, or magnetic colleges) and the second-tier colleges (*pu tong gao xiao*, or regular colleges). That is, the numerator in the measurement (5) roughly measures how much the raw score exceeds the first cutoff line; and then we use the difference between cutoffs for the first- and second-tier colleges as the goalpost to adjust this difference between the raw score and the first cutoff. It can be shown that this z-score type measure is a linear transformation of the percentile of student $i$'s raw score in the distribution under the assumptions (1) scores in a province in each year follows the normal distribution; (2) that the percentiles that correspond to the two cutoffs are constant over time in each province.[10]

Figure 1 shows the patterns of the average standardized scores for teaching and non-teaching majors over time. Figures 1(a) (b) (c) show the average standardized maximal, mean, and minimal scores respectively. We can see from the figure that standardized scores for teaching and non-teaching majors went hand-in-hand before 2007. The trends have diverged since 2007. Students enrolled in teaching majors on average have higher scores than those in non-teacher majors. It suggests that the conditional grant program has raised the overall quality of incoming students for teaching majors relative to that

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[10]The proof is in the appendix. We also provide evidence supporting these assumptions.

for non-teaching majors. Panel A in table 1 provides the summary statistics of mean and maximal scores for program teacher colleges before and after the implementation of the grant program. The pattern confirms what is shown in figure 1. Panel B of table 2 shows the summary statistics of mean and maximal scores for non-program teacher colleges in our sample. From panel B we can see that the difference in entry scores between teaching and non-teaching majors did not change significantly after the introduction of the grant program. Therefore, these non-program teacher colleges can serve as a comparison group.

Since we use major-level scores, one concern may arise that the changes in the scores were caused by changes in the enrollment quota for majors in the teaching track. We further show the pattern of enrollment quota over time in figure 2. It can be seen from this figure that the share of enrollment in the teaching tack in total enrollment in the six program colleges has almost doubled (increased from 20% to 40%) after 2007. Other things equal, the increase in the enrollment quota in the teaching track is supposed to drive down the mean or minimal scores for the relevant majors, as more lower-score applicants have a chance to be admitted. Since we have seen that the overall scores for the teaching majors have increased rather than decreased, it is unlikely to be driven by the changes in the enrollment quota. Our estimate for the changes in overall quality of incoming students is therefore a conservative one.

## 4.3   Identification Strategy

This subsection describes the identification strategy to isolate the program effect. In our benchmark model, we first apply the difference-in-differences (DID) type model to the sample of program teacher colleges. Since teacher colleges in China are typically universal colleges offering both teaching and non-teaching majors and only students in teaching majors are eligible for the conditional grant after the policy change, we can consider teaching majors as the treatment group and non-teaching majors as the control

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group. By comparing the change in the score for those majoring in teaching after the implementation of the grant program to that for those majoring in non-teaching majors, we are able to eliminate the time effect. The regression is specified as follows:

$$Y_{ijst} = \alpha_0 + \alpha_1 T_{ij} + \alpha_2 post_{jt} + \alpha_3 T_{ij} \times post_{jt} + X_{ijst}\gamma_1 + \theta_s + \mu_j + \lambda_t + \epsilon_{ijst} \quad (6)$$

where $Y_{ijst}$ is the (average or maximal) score of students from province $s$ of major $i$ in college $j$ at time $t$; $T_{ij}$ is an indicator for teaching majors, it takes the value of 1 if major $i$ in college $j$ is a teaching major and 0 otherwise; $post_{jt}$ is an indicator for the introduction of the grant program to college $j$, it takes the value of 1 if college $j$ is a program school at time $t$ and 0 otherwise; $X_{ijst}$ is a vector of covariates including the admission quota of major $i$ for province $s$ in year $t$, per capita GDP in province $s$ at time t, and the total number of college applicants in province $s$ at time $t$. We will also control for provincial fixed effects $\theta_s$, college fixed effects $\mu_j$, and year fixed effects $\lambda_t$. $\alpha_2$ in regression (6) thus captures the program effect on scores of incoming students.

Note that the assumption underlying the DID approach is that teaching majors and non-teaching majors would have parallel trends in the quality of incoming students. There may be concerns that the time trends differ between the two types of majors. For example, the willingness of students to join the teaching profession as opposed to other professions may be increasing or decreasing over time, which is likely affected by changes in the labor market over time. In such cases, our DID estimates would be confound by other factors. To rule out this concern, we include teacher colleges which are not eligible for any of these grant programs during the studied period and use them as an additional comparison group. Thus the difference in score changes between teaching and non-teaching majors in these non-program schools should be able to capture the difference in the trends between the two types of majors. Subtracting this difference from the above DID estimate will yield a more accurate estimate for the policy effect by teasing out the different impacts of the labor markets. This leads to the following

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difference-in-difference-in-difference (DDD) specification:

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\begin{aligned}
Y_{ijst} = {}& \beta_0 + \beta_1 T_{ij} + \beta_2 post_{jt} + \beta_3 program_j + \beta_4 T_{ij} \times post_{jt} + \beta_5 program_j \times post_{jt} \\
{}& + \beta_6 T_{ij} \times program_j \times post_{jt} + X_{ijst}\gamma_2 + \theta_s + \mu_j + \lambda_t + \epsilon_{ijst} \qquad (7)
\end{aligned}
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where $program_j$ is an indicator for program colleges, it takes the value of 1 if college $j$ is a program college and 0 otherwise. The coefficient $\beta_6$ is thus the DDD estimate for the program effect.

# 5 Results

## 5.1 The overall program effects

Table 2 presents the estimation results for the DID model (6). Columns (1) and (2) show the results for the mean and maximal scores respectively, without any control. Compared to non-teaching majors, the teaching majors have seen a significant increase in maximal scores of the incoming students after the introduction of the conditional grant program. The increase in the mean score is statistically insignificant. This result suggests that the conditional grant program attracted high-achieving applicants into the teaching majors. Since the enrollment quota for teaching majors increased simultaneously, more lower-achieving applicants may have a larger chance to get in these majors. These two effects combined explains the insignificant change in the mean scores.

Columns (3) and (4) in table 2 list the results for regression (6) with a set of covariates, including the size of major, its square and cubic term, the total number of admission for teaching majors within the province, track dummies, college dummies, and province dummies. The estimated program effect on the maximal score becomes significant at the 1% significance level, but the magnitude is little bit smaller (0.092 vs. 0.14 in column (2)) while the program effect on the mean score remain insignificantly positive. One concern is that our DID estimates might keep diminishing if more covariates are included. So

we further control for the number of applicants in each province-year and results for the mean and maximal score are reported in columns (5) and (6) respectively. The magnitude of our estimates essentially remains stable, if not increase. Also the estimated program effect on the mean score is significant at 10%. Therefore, the estimated policy effect is unlikely to diminish to zero as we control for more variables.[11]

As mentioned in section 2, colleges may have local bias and preferential policies for local enrollment may change over time while the enrollment policy for other provinces is likely to be consistent over time. To eliminate this effect caused by such local bias, we also run the same set of regressions using the non-local in columns (7)-(12) of table 2. The results are similar as or even stronger as those using the full sample. A possible explanation is that the local enrollment quota for the teaching majors increases more than that for non-teaching majors, which will offset more of the potential score increase.

We also run the same set regressions after taking log of our dependent variables to reduce the skewness of the score distribution. Again, our results are still robust. So we will use the set of controls in columns (11) and (12) as our baseline specification and restrict to the non-local enrollment subsample in the following analysis.

If teaching majors become relatively popular, higher-achieving applicants will be attracted into these majors overtime for reasons unrelated to the grant program, which would confound our DID estimates. To rule out this concern, we make the use of the other 32 non-program first-tier teacher colleges as an additional comparison group. These non-program teacher colleges are the most comparable ones with the 6 program colleges in terms of academic reputation and student quality. The differences in the changes of incoming students' scores between teaching and non-teaching majors in these non-program teacher colleges should capture the differential trends in the two types of majors that are

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[11]The number of observations is smaller than that for regressions in columns (1)-(4) because the information on the number of applicants is missing for some provinces in some years. Yet all previous results remain stable if we use this subsample in columns (5) and (6) for regressions in columns (1)-(4). The results are available upon request.

not resulted from the conditional grant program. It allows us to use the DDD specification in regression (7).

The DDD results are reported in table 3. Columns (1) and (2) list the regression results for the mean and maximal scores respectively using the whole sample of the 39 colleges. The results are consistent with the DID results: the program effect on mean scores is positive yet statistically insignificant; the effect on maximal scores is positive and significant at the 10% level.

## 5.2  Sources of the overall program effect on students' scores

The above results consistently show that the conditional grant program successfully attract better students into the teaching track. However, is this effect strong for students from disadvantaged regions such as western regions which have been the primary target of this program? We further explore the regional differences in the program effect. We divide the sample into three regional groups based on the origin of students: ranking from economically advanced to economically backward, namely eastern, middle, and western regions.[12]

We apply the DDD specification (7) to these three subsamples. The results are reported in columns (3) - (8) in table 3. Contrary to the goal of improving teacher quality in disadvantaged areas, the effect seems to be most significant in eastern regions, with both mean and maximal scores increased significantly. For the western regions, the program effect on the maximal scores is negative and insignificant while the effect on the mean scores is negative and significant at the 10% level.

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[12]We follow the official delineation stipulated by the national government in 1986: eastern regions include Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan; middle regions include Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi; western regions include Sichuan, Guizhou, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

We also allow the program effect to vary by time and report the regional policy effect by year in columns (3)-(8) of Table 4. Both adjusted mean scores and maximal scores increase significantly in the East and Middle, with a larger increase (0.58) in the East and smaller increase in the Middle (0.22) in 2007. Moreover, such positive policy effects continue in 2008 and 2009 in these two regions. On the contrary, the scores of the students from the western provinces decline significantly since 2007. And such negative effects remain significant in the following sample period.

These results demonstrate that most of the positive effect of the grant program arises from applicants in the more developed eastern regions. The high-achieving students in western regions tend to turn away from teaching majors after the introduction of the grant program. There are two types of explanations for this pattern. The first possible explanation is that based on the changes in the college supply of enrollment quota. If the enrollment quota increases in the western regions and decreases in the eastern regions, the teaching majors would become more selective for students of eastern regions and hence the mean score would increase. The second possible explanation is based on the demand of applicants. High-achieving students tend to shun away from teaching majors for fear of being locked in their poor hometown after graduation while teaching in the more developed regions is more desirable and not a deterrence to high-achieving applicants who find the grant attractive.

Since we have controlled for the enrollment quota (and its square and cubic terms), the regional difference in quota increase does not seem to be the main driving force of the above results. Moreover, the results in table 4 show that the program effect is also negative for maximal scores of applicants from western regions, which is not supposed to be affected by changes in the enrollment quota.

To check whether the results are more likely to be driven by the changes in the demand of applicants, we further explore how the program effects vary across the location of colleges. The labor market mobility in China is limited by the *hukou* system. *Hukou* is linked to many local facilities, such as public education, pension and health system

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and sometimes even the eligibility of purchasing a car license or an apartment. If a college graduate cannot find a job in the city where the college is located, most likely he/she will go back to his hometown. It would be much difficult to find a job which can grant him/her local *hukou* in other places. Before the introduction of the grant program, given the same academic quality, colleges in eastern regions also carry a positive option value because graduates from these regions have a greater chance to find a job in more developed eastern regions. In contrast, this option value for colleges in western regions is negative because finding a job in western regions is not desirable. Since the conditional grant program requires graduates to return to their hometown, these option values would disappear. Therefore, we would expect to see that colleges in eastern regions become less attractive than before while those in western regions become more attractive. High-achieving applicants especially those from eastern or middle regions are more likely to enter the western colleges than before as their return to their more developed hometown is guaranteed.

Table 5 reports the estimation results by college location. Columns (1) and (2) in panel A present the DID estimates for colleges in the three regions using the sample of applicants from across the country. These estimates confirm our predictions: the program effect on eastern colleges is negative for both the mean and maximal scores, though they are statistically insignificant. Yet for middle and western colleges the program effects on both mean and maximal scores are generally positive, suggesting that these colleges become more attractive after the introduction of the grant program. We further divide the sample by the home province of applicants. Columns (3) and (4) in panel B of table 5 list the DID estimates of the program effects on the mean and maximal scores respectively of applicants from eastern provinces for colleges located in different regions. In general, eastern colleges become less attractive to high-achieving applicants from eastern provinces while middle or western colleges have seen an increase in the scores of incoming students from eastern regions. The effect is weaker for applicants from middle and western regions.

We also apply the DDD model to the above analysis. The estimates of program effects for each subsample are reported in panel B of table 5. The DDD estimates exhibit a similar pattern as the DID estimates.

# 6    Discussion and Conclusion

We examine the effect of the conditional grants in normal universities on the quality of incoming teacher trainees. We find that the grants generally increase the student quality, given enrollment expansion, in teaching majors. The largest effects are found in the economically developed provinces (eastern region). Contrarily, we also find significantly negative policy effect in the least developed provinces (western regions), where the teacher shortage is more urgent. There might be two channels through which the conditional grant exert opposite impacts on different regions: on the one hand, the expansion of normal enrollment is much greater in the West and offset the would-be increase in student quality; on the other hand, high quality student in the West may view the "back home teaching" obligations involved in the grant package as a huge opportunity cost and thus become hesitant about participating the program. The available data do not allow us to directly disentangle these two channels. But the weight of the evidence favors a demand side story, which has deeper policy implications: if students are rational in making the trade-off between present and future benefits as this demand-driven story suggests, the policy has to increase the expected future return of students in order to attract better teacher trainees.

# Appendices

## Justify the construction of score measures

Assume that the raw score for student $i$, $s_i$, from a given province $s$ in year $t$ follows the normal distribution with the mean $\mu_{st}$ and standard deviation $\sigma_{st}$. Then the percentage of students who pass the thresholds for first-tier and second-tier colleges in province $s$ are respectively $\Phi_A = \int_A^\infty f(x|\mu_{st}, \sigma_{st})dx$ and $\Phi_B = \int_B^\infty f(x|\mu_{st}, \sigma_{st})dx$. The first- and second-tier threshold can thus be expressed as a function of $\Phi_A$ and $\Phi_B$ using the error function.

$$A = \mu_{st} + \sigma_{st}\sqrt{2}Erf^{-1}(1 - 2\Phi_A) \tag{8}$$

$$B = \mu_{st} + \sigma_{st}\sqrt{2}Erf^{-1}(1 - 2\Phi_B) \tag{9}$$

By definition, the error function is identical to the cumulative density function of standard normal distribution $Erf(x) = 2\int_{-\infty}^x f(x\sqrt{(2)}|0, 1)dt$. For convenience we define $x_A$ and $x_B$ as $\Phi_A = \int_{x_A}^\infty f(x|0, 1)dx$ and $\Phi_B = \int_{x_B}^\infty f(x|0, 1)dx$ respectively. That is, $x_A$ and $x_B$ are the percentiles corresponding to the first- and second- tier threshold respectively. Therefore we have

$$A - B = \sigma_{st}(x_A - x_B). \tag{10}$$

So the difference between the first- and second-tier threshold $(A - B)$ is proportional to the standard deviation of the distribution under the assumption that the above-defined percentiles $x_A$ and $x_B$ are constant over time for each province. This is an assumption that can be verified using the data on the percentiles. Figure A.1 and Figure A.2 show the enrollment rate at the first threshold and the second threshold during our sample period by province and track.

Similarly, we have that $s_i - A = \sigma_{st}(x_i - x_A)$. So our constructed score measure

$$\frac{s_i - A}{A - B} = \frac{x_i - x_A}{x_A - x_B} \tag{11}$$

That is, the normalization of any score $s_i$ is a linear function of $x_i$, the percentile of $s_i$ in a standard normal distribution.

Therefore, if the assumption holds that the percentile $x_A$ and $x_B$ are constant over time within each province, the score index that we construct above is comparable over time. To justify this assumption, we collect the information on the percentiles corresponding to the cutoffs for the first and second tier colleges, as shown in figures A.1 and A.2. The information is available only in approximately 10 provinces during our sample period. Yet we can see that it is largely constant over time.

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