The Impact of the Influx of New Foreign Undergraduates on American Universities

Ying Shen

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Abstract

Over the past ten years, the United States experienced a dramatic increase in the number of foreign students at undergraduate programs. Using data from the 2001-2013 Integrated Postsecondary Education Data System (IPEDS), this paper examines the impact of the influx of new foreign undergraduates on the U.S. higher education sector. To address the endogeneity of the influx of foreign students, I use plausibly exogenous variation created by the foreign demand shock for American undergraduate education induced by Chinese students since 2006 and implement an instrumental variables (IV) strategy. I find that although the crowdout effect between the enrollment of foreign students and the enrollment of native students is imprecise on average, this crowdout effect is particularly strong at large universities. Admitting more foreign students has little impact on fees in both public and private schools, but it does increase tuition charged by public research universities. Moreover, the economic gains of enrolling foreign students allow American universities to increase the average amount of institutional grant aid for its accepted students as well as the average salary for its instructional staff.

Keywords: Higher education; Foreign students; Crowdout; Tuition and fees; Institutional grant aid; Salary; Instrumental variable

JEL Codes: A22; I23; J15; K37

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1. Introduction

The United States is the largest and most important host of foreign students in the world, and China is its biggest source of foreign students. In recent years, with the rapid economic development in China, and the relaxation on student visa policies by the US government, the number of international students studying in the U.S. has increased dramatically. Data from the Institute of International Education (IIE) reveals that from 1993 to 2003 and 2003 to 2013, the number of foreign students studying in U.S. institutions increased by 123,000 and 313,000, respectively, and that 31% of these international students came from China in 2013.[1] Unlike the previous waves of international students (particularly Chinese students), who were mainly concentrated in graduate programs, more and more recent international students are at the undergraduate level.[2] Moreover, in November 2014, the U.S. and China further agreed to relax visa restrictions to each other, with the aim to strengthen the economic relationship between the U.S. and China. In terms of student visas, the new policy allows the visa validity for Chinese students to be extended to five years.[3] President Obama said that the new visa agreement will contribute tens of billions of dollars to the U.S. economy as well as attract a large number of Chinese students to American universities. Therefore, understanding the impact of foreign undergraduate students on universities in the U.S. is not only important for university admissions officers, but also for policy makers formulating appropriate immigration policies.

The large influx of foreign undergraduates could affect the U.S. higher education sector in several ways. First, the rapid growth in the number of foreign students enrolled in American universities will affect domestic enrollment in those schools, and such impact is ambiguous in theory. On the one hand, if the program size is fixed, native students would be crowded out by foreign students. On the other hand, if an institution utilizes the revenue

[1] Source: Open Doors Data, Institute of International Education

[2] Data from the Institute of International Education (IIE) shows that in 2000, the number of Chinese undergraduate students (8,252) in the U.S. is only around one sixth of the number of Chinese graduate student (48,029) in the U.S.; however, in 2013, these two numbers are approximately equal.

[3] In the past, student visas are only valid for one year.

collected from foreign students to expand its capacity and provide more institutional funding opportunities for domestic students, any increase in the number of foreign students would increase the number of natives simultaneously. Second, the influx of foreign students could affect schools' tuition, fees, salaries and institutional grant aid given the fact that foreign undergraduates usually pay a higher fraction of their education. For example, if the foreign demand for undergraduate education exceeds a school's supply, it is reasonable to anticipate that the school will simply increase its tuition and associated fees to generate higher income. However, if the revenue from admitting foreign students is sufficiently large, the school might increase the amount of institutional financial aid for its students and/or salaries for its faculty and staff. Therefore, in this analysis, I particularly address the following questions: First, will foreign students crowd out domestic students from undergraduate programs? Next, since the majority of foreign undergraduates are financially sponsored by their families, to what extent will their influx affect the tuition and fees charged by institutions? Finally, will the foreign inflows improve universities' financial conditions and increase the amount of institutional financial aid for its accepted students and salaries for its instructional staff?

This paper builds on and is distinct from the following literatures. Hoxby (1998) examines the impact of immigrants on disadvantaged American natives in higher education, and finds that immigrants crowd disadvantaged American natives out of selective colleges. Jackson (2014) investigates the impact of immigration on native enrollment in U.S. colleges, and shows that the increase in the immigrant college students does not lead to a decrease in native college enrollment rates. The "immigrant college students" in these two papers, however, are different from the "foreign students" in my paper. The immigrants they look at do not only include non-resident aliens, but also the U.S. citizens and/or naturalized citizens, but the impact of foreign-born (naturalized) U.S. citizens on natives could be fundamentally different from the impact of foreign students on natives and their impact have different policy implications for several reasons.[4] First, while foreign-born naturalized citizens and American natives usually pay the same amount of tuition/fees and compete for scare access resources (such as various types of grants for underprivileged students); foreign students are typically not qualified for those resources and mainly rely on self-financing. As a result, the crowdout effect between foreign students and native students could be either bigger or smaller than the crowdout effect between foreign-born immigrants and natives, depending crucially on how institutions value and use the economic gains from enrolling foreign stu-

[4]Foreign students in this paper only include non-resident aliens.

dents. Second, foreign-born naturalized citizens can legally stay and work in the U.S. after their graduation, so even though immigrants crowd natives out of higher education, the crowdout effect would not harm the U.S. in the long run as long as those immigrants make sizable contributions to the U.S. economy. However, foreign students are more likely to leave the U.S. after they complete college due to some voluntary and involuntary reasons,[5] so if foreign students crowdout natives, it would result in profoundly negative effects on the U.S. economy and society because a number of qualified high-skill American students are displaced by their foreign cohorts at higher education system. Given its difference from the existing literature and its significance both in academia and in practice, in this analysis, my focus is on foreign students.

Two closely related papers that investigate the impact of foreign students on higher education. Borjas [2004] attempts to address the impact of foreign students on domestic enrollment at graduate level, and the results suggest an imprecise crowdout effect on average, though the negative correlation is stronger for white native men and at the most elite institutions. Borjas et al. [2015] investigate the relationship between the enrollment of Chinese students and the enrollment of other students in mathematics Ph.D programs and find a sizable crowdout effect. However, these papers are focused on graduate programs during the 1980s and 1990s, and with the faster growth rate of the influx of foreign undergraduate students in the U.S. these days, the results of the crowdout in graduate programs in the past may not be reliable enough to forecast any accurate generalizations applicable to the impact on undergraduate programs in recent years. Neverthless, it is interesting to compare the results on undergraduate programs with the results on graduate programs.

This paper makes three main contributions to previous studies. First, to the best of my knowledge, it is the first to comprehensively estimate the impact of new foreign undergraduate students who came into the U.S. after 2006 on U.S. universities. In addition to investigating the effects of foreign inflows on native enrollments, I also examine the impact of foreign students on other institutional outcomes, including schools' tuition, fees, salaries and institutional grant aid. Second, In order to isolate the causal effect, I exploit both time-series and cross-sectional variation. Specifically, my identification relies on both the suddenness of the foreign demand shock for the U.S. undergraduate education induced by Chinese students after 2006, and cross-university variation in the number of foreign students prior to the shock. The former serves as a natural experiment given that the foreign demand

[5]Notebly, the H1-B visa cap prohibits many foreign students from staying and working in the U.S..

shock is orthogonal to a particular American institution, and the latter is useful because pre-shock variation in international students predicts future student inflows. Finally, since the foreign demand shock occurred around 2006 is greatly attributed to the relaxation in student visa policies, and the U.S. government tends to further loosen visa restrictions to international students, this study provides an evaluation of the effects of the most recent student visa relaxation policy on the U.S. higher education system and offers guidance for future visa policy-making decisions.

My results indicate that, institutions that have more earlier foreign students before the demand shock disproportionately enrolled more new foreign students after 2006. The instrumental variable (IV) results suggest although there exists no significant crowdout effect between foreign students and typical native students on average, this crowdout effect is strongest at the largest universities. In addition to the crowdout effect, I also look at the impact of the influx of foreign students on some other outcomes of interest to examine whether the influx affects the tuition and fees charged by institutions, institutional financial support for students and salaries for faculty and staff. I find that, the foreign influx has little impact on institutions fees, though it increases the tuition at public research universities. Moreover, it seems to be the case that admitting more foreign students enables universities to moderately increase the average amount of institutional grant aid for its accepted students as well as the average salary of its instructional staff in American universities.

The remainder of this paper is organized as follows: Section 2 provides a brief description of the background of the foreign demand shock for the U.S. undergraduate programs after 2006. Section 3 explains the construction of the data set and presents descriptive statistics. Section 4 outlines the conceptual framework and empirical identification strategy. Section 5 reports results and robustness checks. Section 6 gives a conclusion and discussion.

2. Background

After the establishment of the People's Republic of China in 1949 until now, the number and the characteristics of Chinese students studying in the United States have gone through several stages. Between 1949 and late 1970s, due to the "leaning to one side" policy[6] and the Culture Revolution[7], the United States only received a trivially small number

[6]Between 1949 and 1960s, the Chinese government was firmly committed to the Sino-Soviet alliance. In terms of higher education context, the government implemented the "learning to one side" policy, and the Soviet Union was the dominant country receiving Chinese international students. (He, 2008)

[7]The Cultural Revolution began the spring of 1966 and lasted until October 1976. During those 10

of Chinese students. Beginning from 1979, as the "Open Up" policy was implemented in China and the Chinese government encouraged Chinese students to study abroad and learn from the Western developed countries, a large number of Chinese students entered American institutions. By the late 1980s, although China had become the leading sender of international students to the U.S. , the majority of Chinese students were concentrated in doctoral programs in the United States because these doctoral programs were the most generous in admitting international students.[8]

However, beginning in 2006, a new pool of Chinese students enrolled in the undergraduate programs in the U.S.. Figure 1(a) illustrates the number of Chinese undergraduate students in all fields studying in American institutions between 2000 and 2013. It is evident that there was a sudden and dramatic increase in the number of Chinese undergraduates sometime around 2006. In fact, the number of admitted Chinese undergraduate students increased almost four-fold in this period, going from 59,939 to 235,597, so Figure 1a strongly confirms the existence of an exogenous demand shock of Chinese undergraduate student for the U.S. undergraduate schooling after 2006. In the rest of this section, I will discuss two reasons that make 2006 an important starting year of the sharp increase in the entry of foreign undergraduates from China (the leading sending country).

The most important reason that leads to a large influx of Chinese students is that, in 2005, the U.S. government relaxed student visa policies and expedited the visa application process, so Chinese scholars and students can come to the U.S. more easily and quickly. After the Sept. 11, 2001, in the wake of terrorist attacks, the U.S. government tightened the visa-approval process for foreign students hoping to study in the U.S., so students from China, which has high immigration rates, were particularly affected by this policy. Not surprisingly, the post-9/11 policy had dramatically increased the barriers to international students to the U.S..[9] Not only the post-9/11 visa policy affected the accepted students and let them unable to make their study in U.S. institutions, but also attacked potential foreign applicants' enthusiasm. [10]

years, the Chinese government implemented a closed-door policy, isolating itself internationally, both from the communist alliance and from Western developed countries. Therefore, the Culture Revolution shut down the opportunity for any Chinese student to study abroad. (Wang, 2001)

[8] Institute of International Education (2013) and Institute of International Education (2009).

[9] Data from the U.S. Embassy show that in 2000-2001 academic year, around 19,000 Chinese students were approved to study in the U.S.; however, in 2002-2003 academic year, this figure had decreased to 13,000.

[10] As the Harvard University President Lawrence H. Summers wrote in a letter in April 2004: The drop in the number of applications from Chinese and Indian students is particularly striking. Applications from Chinese students alone declined as much as 40 percent in some of our graduate programs.

Given the facts that such restricted visa policy towards international students might have adverse effects on America's position at the forefront of technological and academic innovation, in 2005, the United States and China achieved an agreement on relaxing visa requirements for students and scholars. Under the new visa policies, the Chinese citizens applying for student visas (F-1/F-2), exchange visas (J-1/J-2) and vocational training visas (M-1/M-2) are allowed to get visas that are valid for twelve months and multiple entries, compared to the previous six-month and two entries. In addition to the extension of the validity of visas for Chinese students and scholars, the U.S. Department of Homeland Security relaxed certain visa requirements for foreign students and researchers working in sensitive scientific and technical areas where most Chinese students enrolled,[11] and expedited the process of "Visas Matins Checks".[12] Moreover, the new agreement significantly reduced the refusal rate of Chinese student visas. A survey conducted by American Physics Society that tracks Chinese students' visa problems suggest that during 2001-2002 academic year, a Chinese citizen was about three times as likely to have experienced some student visa problem on average.[13] Compared to other foreign students, however, the visa approval rate for Chinese students increased dramatically after 2006—for example, in 2003, the pass rates for student visa (F-1) was around 54% in China, or about half of Chinese students experienced at least one student visa refusal; but in 2009 and 2013, the pass rate for F-1 rose to 85% and 90%, respectively. The increase in the approval rate to Chinese students, therefore, has greatly and effectively promoted the enthusiasm of Chinese students applying to American institutions.

In addition to the changes in visa policy, the Chinese renmibi (RMB) has appreciated against the U.S. dollar by more than 30% since July 21st, 2005 when the Chinese government announced the changes in its official exchange rate regime.[14] Figure 9 plots the exchange rate of RMB against the U.S. dollar between 2000 and 2014. As the figure clearly shows, before 2005, the value of the renminbi was pegged to the U.S. dollar, and the exchange rate of the U.S. dollar to the RMB was hovering around 8.27; however, right after July 2005, the

[11] The"Sensitive Majors" list includes most engineering disciplines, chemical and biochemical/biomedical sciences, certain branches of physics, nuclear and laser technologies, and even urban planning.

[12] Visa Mantis Checks are required for individuals who are involved in any of the technologies included on a list of 15 areas.

[13] Specifically, A Chinese citizen was almost four times as likely to have experienced a student visa problem he or she ultimately overcame in time, and was two and a half times as likely to have experienced a student visa problem he or she could not overcome in time for the start of the 2001-2002 academic year.

[14] The Chinese government removed the renminbi's peg to the U.S. dollar on July 21, 2005, and switched into a managed floating exchange rate mechanism based on market supply and demand, with reference to a basket of currencies.

RMB continues appreciating, and the central parity rate of the renminbi stood at around 6.2 yuan per dollar at the end of 2013. As a result of the appreciation of the renminbi, studying in U.S. colleges becomes much cheaper than in previous periods. Therefore, compared to other countries, such as the U.K., Australia and Canada, which also traditionally receive a considerable number of international students, the United States has become more attractive to Chinese families, inducing more Chinese students to choose the U.S. as their destination rather than any other places.

Taken together, a combination of the appreciation of the Chinese currency against the U.S. dollar, and easier and quicker student visas application procedures for Chinese students has led to a significant increase in the number of Chinese undergraduates in American universities after 2006. Although the plausibly exogenous foreign demand shock for the U.S. undergraduate education induced by Chinese students provides an opportunity to investigate the effects of foreign students on institutional outcomes, my identification does not only rely on the difference in time dimension because latter cohorts might be different from earlier cohorts in various aspects. In the rest part of this paper, in addition to compare institutional outcomes in pre-shock periods with those in post-shock periods, I will also explore cross university variation to capture out other factors other than the foreign demand shock that might affect institutional outcomes in the first and second periods.

3. Data

The core data in this analysis comes from the Integrated Postsecondary Education Data System (IPEDS) from 2001 to 2013. IPEDS provides detailed information on institutional characteristics, institutional prices, enrollment, student financial aid, degree completions, and institutional resources of higher education. For each year, each institution reports the number of students enrolled by race and ethnicity both at undergraduate and graduate levels, tuition/fees they charged, institutional grant aid they offered, average salary for faculty and staff, and other characteristics.[15]

Since the background section confirms the existence of an exogenous demand shock of Chinese students for the U.S. undergraduate education resulting from changes in exchange rate and visa relaxation, and such demand shock is more significant for undergraduate students who mainly rely on financial self-support, so my empirical study focuses on un-

[15]The completion of all IPEDS surveys is mandatory for institutions that participate in or are applicants for participation in any federal student financial aid program.

dergraduate programs. Ideally, I want to collect the information on the number of Chinese students enrolled at a particular program in a particular year and see how the influx of Chinese students affects institutional outcomes. However, in the IPEDS database, each school does not report the number of students by country; they only report the number of nonresident aliens. Therefore, in the paper, I use the demand shock of Chinese students for American undergraduate services to generate variation in the number of nonresident aliens (which, for simplicity, I will refer to as "foreign students"), and examine the effects of foreign students on U.S. institutions. Given that China is the dominant sending country of international students in the U.S., it is reasonable to anticipate a sudden and dramatic increase in the number of Chinese students would also be reflected in the increase of the number of nonresident aliens. Figure 1(a) and Figure1(b) illustrate the number of Chinese undergraduate students and the total number of international students in all fields studying in American institutions between 2000 and 2013, respectively, and we can see that though not perfectly correlated, the patterns of these two figures are very similar, suggesting that the demand shock induced by Chinese students leads to an increase in the number of foreign students in the U.S. after 2006.

To avoid great heterogeneous characteristics among different types of colleges in the U.S. and to account for the reality that international students (especially Chinese students) are more familiar with U.S. national universities than liberal arts colleges,[16] community colleges and/or other types of colleges, in this paper, I restrict my attention to U.S. research universities that provide 4 years or more of higher education.[17] I calculate the total number of students enrolled in each institution if they are enrolled as full-time first-time undergraduate students. To get a balanced panel, I exclude institutions that only appear in pre-shock or post-shock periods. By construction, I get 246 institutions and cluster the data at institution-year level, so in total, the panel tracks the institutional outcomes of 246 institutions over 13 years. Figure 2 presents the average number and the average fraction of foreign students in each university over 2001 and 2013 period. [18]The figures clearly show the increase in both the number and the fraction of foreign students in U.S. institutions after 2006.

Table 1 reports summary statistics in my sample. From Column (1) to Column (3), I

[16]There are no liberal arts colleges in China.

[17]Based on Carnegie Classification 2010, research universities refer to research universities (extensive) and research universities (intensive).

[18]The fraction of foreign student is calculated by dividing the total number of nonresident aliens by the total number of students.

present the mean statistics for the entire sample, before the shock periods and after the shock periods, respectively. For tuition and fees variables, I distinguish them by different types of schools: public versus private. All tuition, fees, institutional grant aid and salary variables are dollars and are deflated by the Consumer Price Index (CPI).[19] Annual CPI-U data is provided by the U.S. Department of Labor Bureau of Labor Statistics. From the table we can see that: First, the average number of non-resident alien in each university rises from 48 to 99 after 2006. Second, private schools charge higher tuition but lower fees, while public schools charge lower tuition but higher fees. After the shock, although the changes in fees are not striking, in-state tuition in public schools, out-of state tuition in public schools, and out-of state tuition in private schools experience 46%, 30% and 22% increase, respectively. Moreover, the average amount of institutional grant aid for the accepted students increases by more than $2,000. The differences of institutional outcomes before and after the shock presage that the influx of foreign students might yield some effects on the U.S. higher education; however, given that the standard errors in the table are big and the possibility that some endogenous factors cannot be controlled by the descriptive table, in the next section, I attempt to systematically test the impact of the influx of foreign undergraduate students on U.S. universities.

The raw trends in Figure 2 and summary description in Table 1, however, just show us a time-series variation but ignore the possibility that there exist heterogeneity in the sample of American institutions. After all, some institutions are heavily affected by the foreign demand shock for education, while others are not. Inspired by Card and DiNardo (2000) and Card (2001) where they use the fraction of earlier immigrants from a given source country to a city as an instrumental variable for the actual inflow of new immigrants of the same source country to the same destination city, I assume that institutions that had more earlier foreign students are more likely to have a larger influx of international students after the shock. In Figure 10, I present a simple plot of the average number of foreign students between 1998 and 2000 (prior to the sample period) against the average number of foreign students between 2006 and 2013 (after the shock).As predicted by the hypothesis, there is a strong positive association between the number of earlier foreign students in a school and the number of newly coming foreign students in the same school.

Before jumping into identification strategy, it is instructive to present graphs. Figure 3 to Figure 6 show difference-in-differences graphs by two distinct groups—"traditional

[19]CPI adjustments such that 100=2013.

welcoming" institutions and "non-traditional welcoming" institutions. To approximately equally split the sample into two groups, the traditional welcoming institutions are defined as those that had more than 85 full-time first-time foreign students between 1998 and 2000, and correspondingly, the non-traditional welcoming institutions are the residual group. By this classification, 127 schools are classified as traditional welcoming institutions and 119 schools are in the non-traditional welcoming group. From Figure 3 (a), we can intuitively see increasing trends in the average number of foreign undergraduates in U.S. universities after 2006, and that the effect on the traditional institutions is significantly larger.

The raw data illustrated in Figure 5 show trends in the average number of native students between these two types of institutions. This graph shows there is no striking differentiation in the enrollment of domestic students between traditional welcoming and non-traditional welcoming institutions before and after the foreign demand shock. Figure 4 and Figure 5 plot patterns of different types of tuition and fees charged by public and private schools for both traditional welcoming and non-traditional welcoming institutions. The obvious differential trends between these two groups after the foreign influx lie in the tuition charged by public schools. It seems that the more affected public institutions (traditional welcoming institutions) have higher increasing trend in tuition relative to the less affected institutions (non-traditional welcoming institutions) after 2006. Figure 6 (a) and Figure 6 (b) illustrate the average amount of institutional grant aid for full-time first-time undergraduate students and the average salary for equated 9 month full-time instructional staff over time, respectively. The figure documents the relative rise in the average amount of institutional grant aid in the traditional welcoming institutions as well as the average salary for instructional staff.

The difference-in-differences graphs suggest that the influx of foreign undergraduate yield effects on certain institutional outcomes. However, the differences between the more affected group and the less affected group illustrated in those figures might be sensitive to the cutoff that I choose to split the sample, and also it is important to notice that the graphic representation might understate the variation. Therefore, rather than just simply dividing the sample into two groups, in the following regression analysis, I use the number of earlier foreign students between 1998 and 2000 as a continuous variable.

4. Methods

4.1 Conceptual hypotheses

Many factors affect a college's admission decision-making, including the relative quality of the applicants, the potential possibility that foreign students pay for a higher fraction of their tuition and fees, and the desire to diversify the student population. Therefore, the influx of foreign students may alter the educational opportunities available to domestic students in different ways. On the one hand, the admission of foreign students can crowd out native students from a particular program, which is called the "crowdout" effect; on the other hand, the enrollment of foreign students (and their tuition dollars) can expand a university's capacity for native students, which is called the "growing" effect.

The crowdout effect may take effect in both direct and indirect channels. The direct channel is, at least in the short run, the number of slots available for prospective students is fixed in a particular school. The increase in the enrollment of foreign students would then imply a decrease in the number of accepted native students. The indirect channel is, the influx of a large number of foreign students can also alter the incentives for natives to pursue some educational programs. Suppose, for example, that many the foreign students enrolled in particular majors (such as STEM fields) choose to stay and work in the United States after their graduation, and the large supply of foreign workers in these STEM majors lower the entry level wages in the STEM-related occupations, then those occupations would become less attractive to natives.[20] Since American students are more flexible in the U.S. labor market, they would shift away from applying to programs in educational disciplines where many foreign students cluster. Therefore, both of these two channels lead to the crowdout effect between foreign students and native students. It is worth noting that, the crowdout effect from the direct channel is specific to a particular university, while the crowdout effect from the indirect channel is the result of an economy-wide supply response and it affects all universities. In the remainder part of this section, I will be focused on the changes that occur in domestic enrollment within a particular university resulting from the increase in the number of foreign students, the economy-wide fluctuations, therefore, will be net out.

Although the influx of foreign students can crowd out native students given the above discussion, the number of domestic students can also be expanded as the size of the foreign student population increases. Since foreign students tend to pay a higher fraction of their

[20] Borjas (2003) and Borjas (2009) provide the evidence on the earning impact of immigration and foreign students in the U.S. labor market. Freeman et al (2001) describe the shifts in the bioscience job market as the consequence of the influx of foreign students.

education (especially in undergraduate programs), institutions' financial condition could be greatly better off following the influx of foreign students, then the institutions can utilize the revenue collected from foreign students to expand their capacity and/or provide more institutional funding opportunities for domestic students. As a result, the university is able to admit more American students.

Unlike the doctoral programs for both foreign and native students that are highly subsidized by taxpayers in the U.S. (Winston, 1999), the undergraduate programs mainly depend on self-support. Compared to native students, foreign undergraduate students usually pay a higher fraction of their education, so we can anticipate that as a considerable body of foreign students flow into American institutions and they pay higher amount of tuition and associated fees, the financial condition of American institutions could be better due to the additional source of revenue. However, the consequences following such economic benefit are ambiguous. On the one hand, if the foreign demand for the undergraduate education exceeds a school's supply, and the school believes it is an easier and faster way to collect tuition and fees from international students, in order to generate higher income, the school will simply increase its tuition and fees. On the other hand, if the economic gains from foreign undergraduate students are sufficiently large, then a school is not necessary to increase its tuition and fees to maintain its operation costs. By contrast, it might be even able to increase the amount of institutional financial aid for the accepted students and/or salaries for faculty and staff using the economic benefit coming from foreign students.

Figure 7 shows a general graphical analysis of the conceptual hypotheses in this work. $p^*$and q^* represent the equilibrium price of education and equilibrium enrollment in the original setting without an exogenous foreign demand shock. The foreign demand shock for education shifts the demand curve outwards, and suppose that the supply for education is very inelastic, then the new equilibrium price p' will be higher than p^* , but the new equilibrium enrollment q' will be very close to q^*. In other words, the influx of foreign student will lead to an increase in price for education (i.e. tuition, fees) and will crowd native students out of the program because the total number of enrollment does not change. However, if universities use the economic gains from admitting foreign students to expand their size which shifts the supply curve outwards as well, the changes in the new equilibrium price p'' relative to p^* and the relationship between the enrollment of foreign students and the enrollment of natives will become ambiguous.

Given the ambiguity of the impact of the foreign students on American universities, in

the following analysis, I discuss empirical identification strategy to investigate how the influx of new foreign undergraduates affects the U.S. higher education sectors in various aspects.

4.2 Identification

Let E_{ust} denote institutional outcomes of interest in school u, in state s at time t, and let F_{ust} denote the respective number of foreign students. The OLS regression model used to capture the impact of the influx of foreign students on institutional outcomes is given by:

$$E_{ust} = \delta_u + \varphi_t + \theta_s + \beta F_{ust} + \varepsilon_{ust} \tag{1}$$

Where δ_u represents a vector of university fixed effects, which is used to net out any university-specific factors that may affect institutional outcomes; φ_t represents a vector of year fixed effects, which is used to net out any time-specific factors that determine outcomes of interest; and θ_s represents a vector of state fixed effects, which is used to net out any state specific factors that influence the institutional outcomes. β is the covariate of interest, and in particular, it measures the effects on institutional outcomes within a particular university when that university enrolls one additional foreign student. The final term ε is the idiosyncratic error term. The standard errors are clustered at university level. It is worth noting that the fact that bigger universities might be different from smaller universities in many dimensions does not invalidate the identification since level effects are differenced out by including university fixed effects.

Estimation of equation (1) by standard OLS regression may be lead to biased estimates of β for different sources of endogeniety. For instance, suppose β is negative, reverse causality could overestimate the OLS estimates, since it could be the case that universities recruited more foreign students because they faced a decline in the demand of qualified native students who want to enroll in their undergraduate programs or because the universities became less generous in offering financial support. Second, the simple OLS regression may mask a possibility that some growing departments are likely to admit large numbers of foreign students and domestic students simultaneously. Such positive and spurious correlation between the number of foreign students and the number of native students at the institutional level in any given year would result in a positive estimate of the coefficient of the crowdout effect (or under-estimate the crowdout effect). Therefore, in order to overcome the endogeneity bias, an instrumental variable strategy is useful.

Inspired by Card and DiNardo (2000) and Card (2001) where they point out that newly immigrants are more likely to gravitate towards enclaves established by earlier immigrants from the same country, similarly, I instrument the number of foreign students by the interactions of two terms, one a continuous number of full-time first-time foreign students between 1998 and 2000 in each university, and the other indicating the relative year to 2005 after 2006. Therefore, the first-stage equation that relates the endogenous regressor to the instrument and other control variables is:

$$F_{ust} = \delta_u + \varphi_t + \theta_s + \sum_{k=1}^{8} \alpha_k (Before_u * PostYear_{k,t}) + \varepsilon_{ust} \tag{2}$$

In this equation, $Before$ equals the number of full-time first-time foreign students in each institution between 1998 and 2000; and $PostYear$ are indicator variables equal one if the year is k years relative to 2005. The omitted category is the years prior to 2005.[21] Since the specification has a set of year dummies and institution dummies, α denotes a difference-in-differences coefficient. However, different from the standard difference-in-differences model, instead of using simple "treatment" and "post treatment" indicators, I use a continuous measure of the number of earlier foreign students prior to the shock and a series of dummies indicating year relative to the pre-shock period, the identification could generation more variations and estimate more dynamic effects.

To be valid, the instrument needs to meet several necessary assumptions. The first assumption for instrument validity and consistent 2SLS estimation is that the instrument should be strong. If the instrumental variables are only weakly related to the endogenous variable, it could potentially lead to biased estimates (John Bound *et.al.* 1995). In this paper there are multiple instruments, I use the Cragg-Donald F-test [22] and compare the statistics to the critical value calculated by Stock and Yogo to test for weak instruments.

Second, the instrument validity requires that the influx of new foreign undergraduate students is exogenous to unobserved institutional characteristics that affect institutional outcomes of interest. In the background section, I have shown that the recent foreign demand shock for American undergraduate education induced by Chinese students can mainly attributed to the changes in the exchange rate and relaxations in student visa policies, thus this concern is not likely to severely affect the results. However, one may worry about

[21] For example, if the year is 2006, then k=1; if the year is 2007, then k=2. If years are prior to 2005, $PostYear$ is 0.

[22] If the number of instruments exceeds the number of endogenous regressors, a simple F-test on the instruments is not reliable.

the scenario that some big universities with many foreign students before the visa relaxation have strong incentives and power to lobby the government to relax international students' visa policies. If that was the case, the new influx of foreign students is not totally exogenous but partially supply induced; therefore, in the robustness check, I present results after excluding ten universities that have extremely large number of foreign students before 2006, and most results still hold if I exclude them from the regressions.

The valid instrumental variable strategy also relies on the assumption that other than difference in the pre-shock distribution of foreign students across universities, there exist no other time-varying factors differentially affect universities that also have impact on institutional outcomes of interest. For instance, suppose that between 1998 and 2000, Stanford University enrolled more foreign students than Yale University did, and the foreign demand shock in Stanford University relative to Yale University was also positive after 2006. In order for the instrument to be valid, after netting out university fixed effects and year fixed effects, the only difference between Stanford University and Yale University that affects institutional outcomes should be the disproportionately increase in the number of foreign student after 2006. This exclusion restriction is fundamentally improvable, but below I discuss some of potential threats. One of the worries is that there might exist time-varying institutional unobservables differentially affect universities with a lot of earlier foreign students versus universities without many earlier foreign students that are correlated with institutional outcomes. To eliminate it as a channel, in the robustness check section, I incorporate institution-specific time trends in the regression and most results are robust. Another concern is that differential pre-shock distribution of foreign students might affect institutions' attractiveness to domestic student. For example, if domestic students think it is relatively hard to make friend with foreign students and/or it is very competitive to compete with foreign students, they would avoid applying for universities that have more foreign students, so the estimated crowdout effect will be biased up. Therefore, I also investigate the effects of foreign demand shock on the number of applications in the robustness check to test this possibility. One may also be concerned that universities with many earlier foreign students tend to expand its school size, so if these universities increase the enrollment of domestic students and foreign students simultaneously, the estimated crowdout effect will be biased down. In order to rule out this possibility, I show that the growth rates of total enrollment before 2006 are not significantly differed across universities with differential pre-shock distribution of foreign students.

The first-stage regression (Equation (2)) is basically a difference-in-differences equation, and a crucial assumption of the difference-in-differences strategy is that pre-trends should be similar between treatment groups and control groups prior to the foreign demand shock. Figure 3 (a) shows the average number of foreign students in the traditional welcoming institutions and non-traditional welcoming institutions, and it seems that the number of foreign students in the traditional welcoming institutions was trending similarly to that in the non-traditional welcoming institutions before 2006. While the figure is helpful in supporting my identification strategy, it is not a substitute for more exactly specified placebo tests since my instrumental variable is not the interaction of two binary variables. Therefore, I will run regressions including institution-specific time trends and propose several placebo tests in the following analysis only using the pre-shock period of the data to ensure the difference-in-difference model is picking up the effect of the foreign demand shock, not some other trends that were present prior to the foreign influx.

5. Results

5.1 First Stage Results

An interesting starting point for empirical analysis is to investigate to what extent the foreign demand shock for American undergraduate education affects the enrollment of foreign students in different institutions. Table 2 display the first stage regression coefficients of the interaction terms $Before$ and $PostYear$ (α_k in Equation (2)). In Column (1), I run regressions on the entire sample; however, the average effect may mask heterogeneous effects across institutions with different characteristics, so from Columns 2-8, I present the first stage results separately by type, size and ranking of institutions. Large schools, median schools and small schools refer to 80 universities that enrolled more than 8,000 total students, 80 universities that enrolled between 4,000 and 8,000 total students and 86 universities that enrolled fewer than 4,000 total students between 1998 and 2000, respectively. "Higher ranking" are schools whose ranking are below 100 while "Lower ranking" are schools whose ranking are above 100 or have no ranking.

The coefficients in Column (1) are all positive and statistically significant at the 1 percent level. Since the coefficients are DID coefficients, they suggest that if a school had one more foreign student between 1998 and 2000, it would enroll an extra 0.065 more foreign students

in 2006 and 0.097 more foreign students in 2007, so on and so forth. There is a clear rise in the magnitude of the coefficient when the relative year to 2005 increases. Separate regressions across the type and the size of institutions reveal that the positive effect between the number of earlier foreign students and future foreign inflows appears to be stronger in public schools, the largest universities and higher ranking schools.The ninth row of the panel give us the Cragg-Donald Wald F statistics associated with the coefficients on my instrumental variable in the first-stage equation. Stock and Yogo calcuate the critical value for a model with one endogenous regressor and eight instruments is 20.25 at the 5 percent level, so except for the "small schools", "median schools" and "higher ranking schools" subsamples, all other F statistics are way above 20.25, suggesting that other than the schools with small size and median size and lower ranking, weak instruments are not a particular concern in this analysis.

5.2 Effects on Domestic Student Enrollment

Given that we have confirmed that the plausibly exogeneous foreign demand shock for American undergraduate education had a disproportionate impact on same American research universities (foreign students are more likely to be enrolled in institutions that had more earlier foreign students), the next thing to consider is the effect of this foreign influx on domestic students' enrollment in American universities using the intrumental variables (IV) estimation. Table 3 reports the second stage coefficient β after using the number of domestic full-time first-time undergraduate students enrolled in school s at time t as the dependent variable and instrumenting the number of foreign students by $before$ and multiple post-shock year dummies. Similar to Table 2, in Column (1), I run the regression on the full sample, and from Column (2) to Column (4), I run regressions based on the type and size of the schools. Because the first stage results are not significant for "small schools", "median schools" and "lower ranking schools", I do not report the second stage results for these three group since the weak intrument cannot give us credible second stage estimate.

The estimated coefficient in Column (1) is -0.5661 (with a standard error of 0.4731) and statistically insignificant, indicating that the crowdout effect between the enrollment of foreign students and native students is imprecise on average. However, this aggregate correlation may mask a great deal of dispersion across different characteristics of institutions. Results in Colum (2) to Column (5) suggest that although there is little evidence of a

crowdout effect for the typical native students in public schools, the crowdout effect is particularly strong in schools with a larger number of students and with higher ranking. In fact, the coefficients for the native enrollment in the largest universities is -1.0482 (with a standard error of .5569) and in the higher ranking universities is -1.3331 (with a standard error of .5389) , suggesting an approximate one-to-one displacement of natives as foreign student enrollment increases in the largest universities and higher ranking universities. It is important to note that this negative coefficient does not indicate that native enrollment for this group of institutions is declining at every university, but the estimated coefficient only indicates that the relative enrollment of native fell in schools that have larger increases in the number of foreign students compared to schools that have fewer increses in the number of foreign students.

To sum up, I interpret the results in Table 3 as that in the largest universities and higher ranking universities, there exists an approximate one to one crowdout effect between foreign students and domestic students. In other types of universities, the crowdout effect might be smaller, but given the estimates for that group are imprecise, I cannot rule out the existence of crowdout at higher education institutions overall.

5.3 Effects on Other Institutional Outcomes

To comprehensively evaluate the impact of foreign influx on the U.S. higher education sector, in addition to the effect between the enrollment of foreign students and the enrollment of domestic students, in this paper, I further use the instrumental variables approach to investigate the impact of the influx of foreign undergraduate students on other institutional outcomes.

The results of Table 4 continue my analysis of the impact of the foreign influx on institutional outcomes using four additional measures: the amount of tuition for full-time first-time undergraduates, the amount of fees for full-time first-time undergraduates, the average amount of institutional grant aid received by full-time first-time undergraduates and the average salary for equated 9 month instructional staff. Because the pricing of higher education in the United States is totally different in both private and public institutions, I distinguish tuition and fees charged by institutions by three types: in-state tuition/fees charged by public school, tuition/fees charged by public school and tuition/fees charged by private school.

Columns 1-3 of Table 4 report the estimated second stage coefficients using different types of tuition as dependent variables. Results in school tuition indicate that if a public school enrolled one additional foreign student, it would increase in-state tuition by around 4 dollars, and out-of state tuition by around 11 dollars. However, if I run the regression using the tuition in private school as a dependent variable, the second stage coefficient is imprecise. Columns 4-6 of Table 4 represent the results on school fees, we can see that all coefficients are very small in magnitude and statistically insignificant. The results indicate that the influx of foreign students has little impact on fees charged by American universities, but it leads to an increase in tuition in public schools.

Up to this point, my analysis has documented the effects of the influx of foreign students on tuition and fees. It is entirely possible, that the beneficial effects of the foreign demand shock would show up in the way that universities increase the amount of institutional financial aid for students and/or salaries for faculty and staff after they benefit from the foreign influx. The economic gains would be, in turn, beneficial for the accepted students and its faculty and staff. In order to examine such a potential effect, I run the regressions using the average amount of institutional grant aid received by full-time first-time undergraduates and average salary for equated 9 month instructional staff as dependent variables, and the estimates are presented in Column (7) and Column (8) of Table 4. The point estimates in Column (7) and Column (8) are 13.21 (with a standard error of 6.2) and 13.63 (with a standard error of 6.03), respectively. In other words, one extra foreign student leads American research institutions to end up increasing both the average amount of institutional grant aid for full-time first-time undergraduate and the average salary for equated 9 month instrutional staff by rougly 13 dollars. I interpret the results as evidence supporting the argument that colleges are able to increase the average amount of institutional grant aid for the accepted students and the average salary for its instructional staff if they admit more foreign students.

5.4 Robustness checks

The crucial assumptions underlying my identification strategy are: First, the instrument does not affect institutional outcomes of interest through other channels other than the influx of new foreign undergraduate students. Second, institutions should not follow differential trends in the number of foreign students prior to the foreign demand shock. In this section,

the validity of the assumptions are extensively discussed and tested.

One concern of using the foreign demand shock for American undergraudate education induced by Chinese students after 2006 as a natural experiment is that it might not be totally demand driven, but partially supply induced since some big universities with a large number of earlier foreign students might have incentives and power to lobby the government to relax the visa policies to international students. If that was the case, the foreign demand shock for education is not completely exogeneous, and the IV estimates will be biased. Figure 11 presents the distribution of the number of full-time first-time foreign students between 1998 and 2000 across American research universities, we can see that there do exist some universities that enrolled an extraordinary large number of foreign students between 1998 and 2000. In order to alleviate this concern, I run the regressions by omitting 10 universities that enrolled more than 400 foreign students between 1998 and 2000. Table 5 reports the second stage results using the interaction term $Before$ and a series of post-shock year dummies as IV when excluding 10 universities. Here I do not show first stage coefficients, but I display the Cragg-Donald Wald F test in the second row, and Cragg-Donald Wald F test for the full sample, public schools and private schools are 64.63, 72.38 and 12.26, respectively.[23] Most coefficients for institutional outcomes are similar to the main results in Table 3 and Table 4, and the big difference lies in the coefficient when using the enrollment of domestic students as the dependent variable, changing from being significant to being imprecise . However, this change seems to be consistent with the finding that the crowdout effect between foreign students and native students is particularly strong at the largest universities, so if I exclude 10 large universities from my sample, it is reasonable to expect that the estimated crowdout effect would be reduced.

The second worry is that some institutional outcomes could be correlated with institution unobservables that differentially affect schools with more earlier foreign students and school with fewer earlier foreign students. Including institution fixed effects can net out the time-invariant institutional impact, but it cannot account for time-varying institutional impact. The feasible way to address this problem is to include institution-specific time trends into the specification, and the second stage results after including state-specific linear year trends are displayed in Table 6 and the first stage results are shown in Table 11. This approach does not only solve the potential concern that time-varying institution unobservables might

[23]Stock and Yogo calcuate the critical value for a model with one endogenous regressor and eight instruments is 20.25 at the 5 percent level and 11.39 at the 10 percent level, so all second stage regressions pass the Cragg Donald weak instrument test at least 10% level.

bias my estimate, but also allows for a test of the identifying assumption in the first stage equation that, the pre-trends are similar across universities prior to the foreign demand shock. The results in Table 6 show that similar to the main results in Table 3, there exist an approximate one-to-one crowdout effect in the largest universities and higher ranking universities. However, comparing to the estimates in Table 4, after including institution-specific time trends, it seems that the influx of foreign students increase tuition in all types of institutions and decrease fees in public schools; the effects on institutional grant aid for the accepted students and average salary for instrutional staff become insiginificant. In sum, some results are not affected by including linear institution-specific time trends in the regressions, but this is a very demanding check since institution-specific trends might take out some of the true effects.

The third concern of using the number of earlier foreign students as an instrument is that the schools with more foreign students prior to the shock might be fundamentally different from the schools with fewer foreign students in many dimensions other than the sudden foreign demand shock. One possible scenario is that if domestic students think it is relatively hard to make friend with foreign students and/or it is very competitive to compete with foreign students, they would avoid applying for universities that enrolled more foreign students, so the estimated crowdout effect will be biased up. By contrast, if domestic students prefer the diversified environment in universities that consist of more international students, and those universities would receive more applications from American students after the foreign influx, so the estimated crowdout effect will be biased down. Ideally, if I could control for the number of domestic applications over time, this channel would be net out. Unfortunately, the IPEDS do not have information about the number of applications separated by domestic and foreign students, but I propose an indirect ways to address this concern. Table 7 report the coefficients of running Equation (2) of using the total number of applications as the dependent variable. Comparing these coefficients with the coefficients in Table 2, it implies that if the acceptance rate for foreign students is between 1% and 10%, then the increase in the number of applications is driven by the foreign applicants, and the number of domestic applications are not differentially affected. However, it seems that, other than the last sub-sample, the universities with more earlier foreign students received more domestic applications than the universities with fewer earlier foreign students did after 2006, implying that except for the "large school" group, the crowdout effect might be underestimated in the overall sample and other sub-samples. Another possible scenario

is that if the unversities with larger number of foreign students between 1998 and 2000 are about to expand their size by admitting more foreign students and domestic students simultanesouly, then the estimated crowdout effect will be biased down. In order to test this possibility, I run the following equation only including the pre-shock period observations:

$$Growth_{ust} = \delta_u + \varphi_t + \theta_s + \gamma Before_u + \varepsilon_{ust} \tag{3}$$

Where $Growth_{ust}$ is the growth rate of total enrollment for university u, in state s and year t. $Before$ equals the number of full-time first-time foreign students in each institution between 1998 and 2000. All fixed effects are defined exactly the same as those in Equation (1). The estimated coefficient γ is .000027 (with a standard error of .000083), the positive sign of the coefficient implies that universities with more earlier foreign students have higher growth rate of total enrollment before the shock, so the crowdout effect might be underestimated in this scenario. However, given its small magnitude and statistical significance, this concern would not greatly contaminate my results.

The fourth potential threat is that because the visa relaxation policies are not only appliable for undergraduates, but also for graduates, so if the university also experienced a large influx of foreign graduate students after 2006 and there exist spillovers from graduate programs to undergraduate programs, then some positive effects I find in the previous context such as the increase in tuition, institutional grant aids and salaries would be biased up. To address this problem, I run the Equation (2) using the number of full-time graduate students as the dependent variable, and the results are reported in Table 8. To compare the coefficients in Table 8 with the coefficients in Table 2 and focus on the most relevent groups including public schools, the largest schools and schools with higher rankings, we can see that although universities with higher number of ealier foreign graduate students between 1998 and 2000 are also more likely to disproportionately enroll more foreign graduate students after 2006, the coefficients are only 1/4 to 1/7 in magnitude of the coefficients in Table 2, suggesting that the foreign demand shock is way bigger for undergraduate programs than for graduate programs. Therefore, even though the influx of foreign graduate students might bias the baseline results upwards, given its relatively less significance, it would not be an important driver of my results.

Another way to attenuate the above discussed concern is to create a triple difference design rather than a difference-in-differences design by looking with majors. The IPEDS

do not report the enrollment information by resident status and major annually, but they provide such information biennially, so in my sample I can gather the information about the undergraduate enrollment by resident status and major in 2002, 2004, 2006, 2008, 2010 and 2012. Figure 8 depicts the pattens of the number of full-time first-time foreign students by major between 2002 and 2012, and it clearly shows that while the number of foreign students experienced a sharp increase in business, engineering, mathematics and physical science after 2006, the number of foreign students in biology/life science and education is stagnant. This phenomenon indicates that business, engineering, mathematics and physical science fields are more affected by the foreign demand shock after 2006. Therefore, I run the following regression using the triple difference as the IV to capture the exogeneous variation in the number of foreign students:

$$F_{usft} = \sum_{k=1}^{4} \lambda_k (Before_u * Post2006_{k,t} * Major_f) + \delta_u + \varphi_t + \theta_s + \upsilon_f + major_f * \delta_u + shock_t * \delta_u + major_f * shock_t + \sigma_{ft} + \rho_{uf} + \varepsilon_{usft} \tag{4}$$

Where the instrument here are the triple interactions of an indicator variable of whether the major is more affected fields, a set of dummies of the year relative to 2005, and the continuous measure of the number of foreign students between 1998 and 2000. $Major$ is a dummy variable which equals one if the major is business, engineering, mathematics or physical science. *Shock* is a dummy variable if year is equal or after 2006. The advantage of using triple difference instrument over the DID instrument is that the exclusion restriction is only violated if there are time-varing differences between universities with larger number of foreign students before the shock and universities with fewer number of foreign students before the shock had differential effects on the more affected majors versus the less affected majors. Because I only have the enrollment information by major and ethnicity, so I can only use the triple difference instrument to investigate the impact of the foreign influx on domestic enrollment, and the first stage and second stage results of full sample are reported in Table 9. The first stage coefficients are positive and statistically significant at the 5 pecent level except for the higher ranking schools,[24] and most coefficients are positive suggesting that within a universities, foreign students are more likely to enroll in the more affected majors and such positive relationship becomes larger when the relative year after 2005 becomes bigger. The second stage coefficients are comparable to the main results in

[24]Stock and Yogo calcuate the critical value for a model with one endogenous regressor and four instruments is 16.85 at the 5 percent level

Table 3, although the estimate is imprecise, the point estimate are still negative and has larger magnitude in the largest universities and higher ranking universities. For the largest universities, the point estimate has a p-value of 0.12, so the point estimate is very close to be marginally significant.

An additional robustness check to test the credibilty of my results is to use an alternative instrument variable (IV). I follow Wozinak and Murray (2012) and use the following IV for current foreign students: $IV = (\frac{F_{u,1998and2000}}{F_{1998and2000}}) * (F_t - F_{u,t})$, where the first term is the institution's share of total foreign undergraduates in the 1998 and 2000, and the second term is the substraction of an insitution's own inflow. Similar to Card, this IV assumes that institution with larger shares of the foreign undergraduates in the prior period are more likely to experience larger changes in their number of foreign undergraduates if there exist a demand shock; however, as an update, this IV also relies on the assumption that flucations in the number of foreign undergraduates in the rest of the school, which are driven by factors exogeneous to u, drive the shocks to the changes in the number of foreign undergraudates. Therefore, the corresponding first stage that relates the endogenous regressor to the new IV is:

$$F_{ust} = \delta_u + \varphi_t + \theta_s + \rho(\frac{F_{u,1998and2000}}{F_{1998and2000}}) * (F_t - F_{u,t}) + \varepsilon_{ust} \tag{5}$$

The second stage results of using the new IV are displayed in Table 10. The associated F statistics in the first stage equation is close to or above 10, so the new IV is not a very weak instrument. The coefficients in Table 10 are quite similar to the main coefficients in Table 3 and Table 4 using DID estimators as instruments, implying that the baseline results are robust results.

In addition, any difference-in-differences identification relies on the assumption that treatment and control groups are behaving similarly prior to the shock. I propose three ways to test this assumption. Table 11 present the coefficients of estimating Equation (2) after incorporating institution-specific time trends in the regressions. The Cragg Donald F-test statistics become smaller, but many of them are still close to the Stock Yogo critical value at the 5 percent or the 10 percent level, expect for the "median schools" sub-sample. If we compare the coefficients in Table 9 to those in Table 2, we can see that except for the "median school", all estimates are robust after including institution-specific trends.

Moverover, I also present several placebo tests only using the pre-shock periods of the

data to ensure that it is unlikely that the difference in prior trends explain my findings. First, I run the following equation to test whether there exist linear trends before the shock:

$$F_{ust} = \delta_u + \varphi_t + \theta_s + \omega Before_u * t + \varepsilon_{ust} \tag{6}$$

However, this approach and the approach incorprating institution-specific time trends only test the assumption if prior differential trends are linear, I therefore implement other placebo experiments by running Equation (2) and moving the foreign demand shock from 2006 to 2003 and 2004. If there are no prior trends among universities, it is expected that the estimated coefficient ω and coefficients before the new interaction terms will yield insignificant results. Table 12 report the results for the placebo tests, as expected, coefficients are all close to zero and most of them are statistically significant.

6. Conclusion and Discussion

This paper examines the impact of the influx of new foreign undergraduates on the U.S. higher education system. My analysis exploits the natural experiment ignited by the sudden demand shock of Chinese undergraduates around 2006. I use data collected from the Integrated Postsecondary Education Data System (IPED), which provides detailed information at the institutional level. The data reveal that universities that had more foreign students prior to the shock experienced a disproportionately large influx of the new foreign undergraduates after the shock.

I use the instrumental-variable strategy to empirically identify the relationship between the enrollment of native students and the enrollment of foreign students. The regression results in this paper suggest that although there is imprecise crowdout effect between foreign students and typical native students on average, this crowdout effect is particularly strong at the largest universities. Additionally, I also carry exercise on examining the impact of the influx of foreign students on other institutional outcomes of interest. The empirical results indicate that the influx of foreign students increase tuition in public schools, but it has little impact on tuition in private schools and school fees in both public and private schools. Moreover, there is some evidence showing that admitting more foreign students leads to an increase the average amount of institutional grant aid for the accepted students, as well as an increase in the average salary for instructional staff.

Education is a cornerstone for a nation development, and higher education plays a sig-

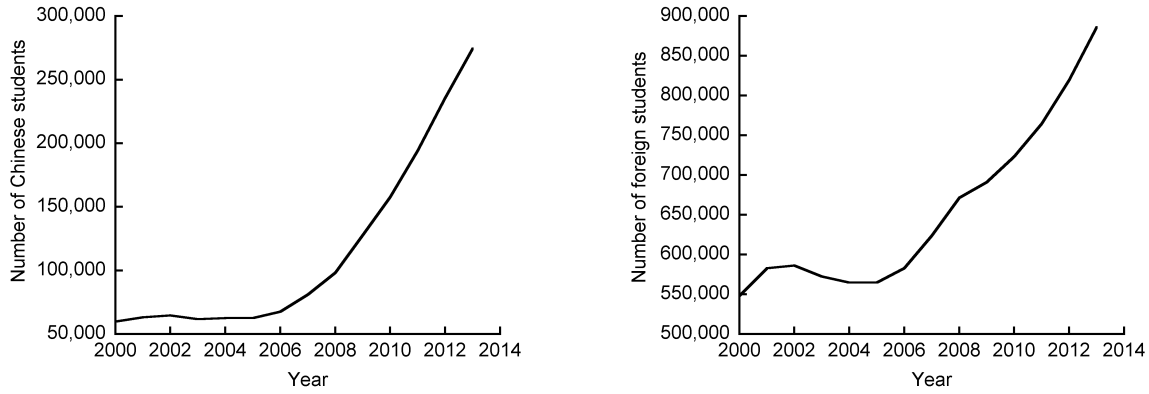
nificant role in maintaining a country's leading economic advantages on the global stage in the long run. Since the U.S. is the most important host of foreign students in the world, examining the effects of the influx of foreign students on American students and colleges has fruitful implications.

The findings in this paper suggest that, from domestic students' point of view, the foreign influx takes their education opportunities, making them unable to access to undergraduate programs, which would further negatively affect their later-life labor market outcomes. From institutions' perspective, admitting more foreign students might have positive effects. As foreign students usually pay a larger fraction of their education, institutions' financial condition are better off following the influx of foreign student and they could be potentially able to provide more institutional grant aid for the accepted students. However, from policy makers' perspective, the implication is more complicated, depending crucially on what happens to foreign students after they complete undergraduate education. If these foreign students stay in the U.S. and make sizable contributions to the U.S. economy after their graduation, it is not a bad idea to reallocate resources to take advantage of the benefits created by those foreign students. By contrast, if these foreign students leave the U.S. right after their completion, even though they can bring some financial beneficial effects on institutions in the short period, they will result in profoundly negative effects on the U.S. economy and society in the long run because a number of qualified high-skill American students are displaced by their foreign cohorts at higher education system.

In sum, the rapid growth of foreign undergraduate students in the past decade has significant impact on the U.S. higher education sector in many aspects. This paper focuses on the impact at the institutional level, but due to the data limitation, little is known about the effects of the foreign influx on each individual, such as peer effects or knowledge spillovers, so future study is needed.

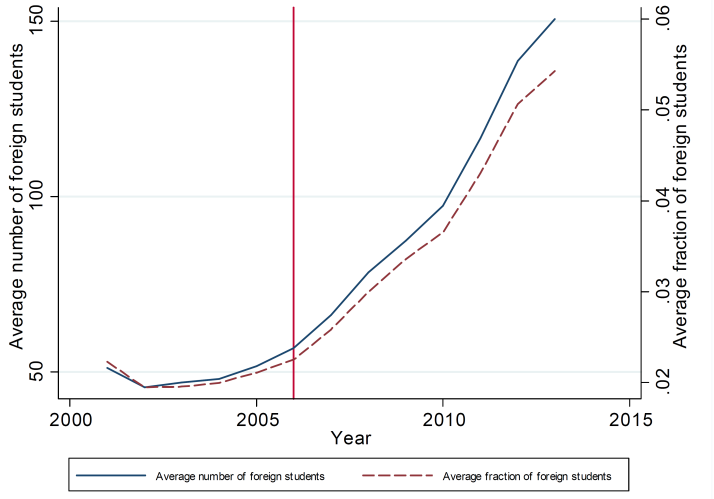
Figure 1: Number Of Chinese And International Students In American Institutions, 2000-2013

(a) Number Of Chinese Undergraduate Students (b) Number Of International Undergraduate Students



Notes: Data is collected from Open Doors Data, *Institute of International Education*

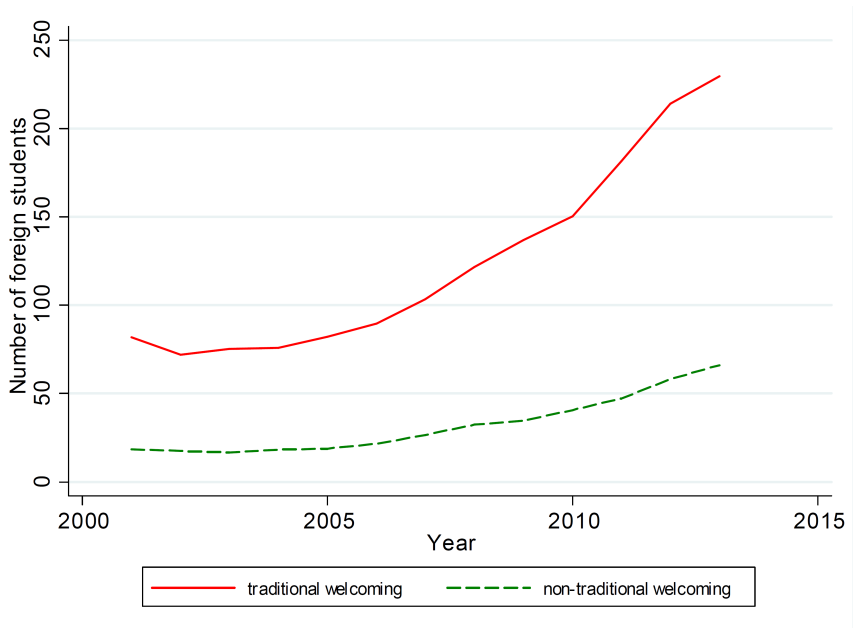
Figure 2: Number And Fraction Of Foreign Students In American Research Institutions, 2001-2013



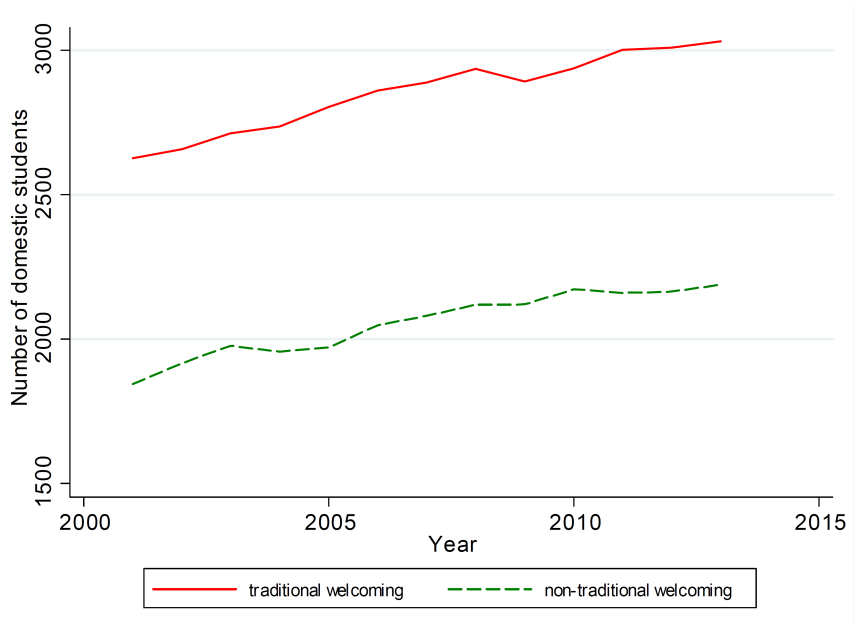
Notes: Data is collected from the Integrated Postsecondary Education Data System (IPEDS). Based on Carnegie Classification 2010, Research universities refer to Doctoral/Research universities (Extensive) and Doctoral/Research universities (Intensive).The fraction of foreign students is calculated by dividing the total number of nonresident aliens by the total number of students.

Figure 3: Average Number Of Foreign Students And Domestic Student In American Research Institutions, By Type Of Institutions, 2001-2013

(a) Average Number Of Foreign Students



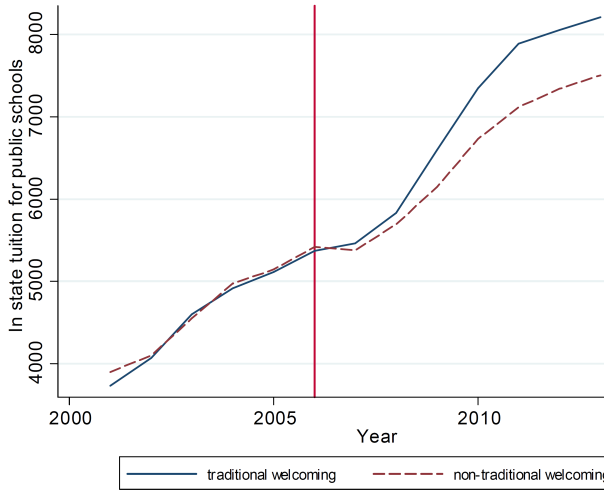
(b) Average Number Of Domestic Students



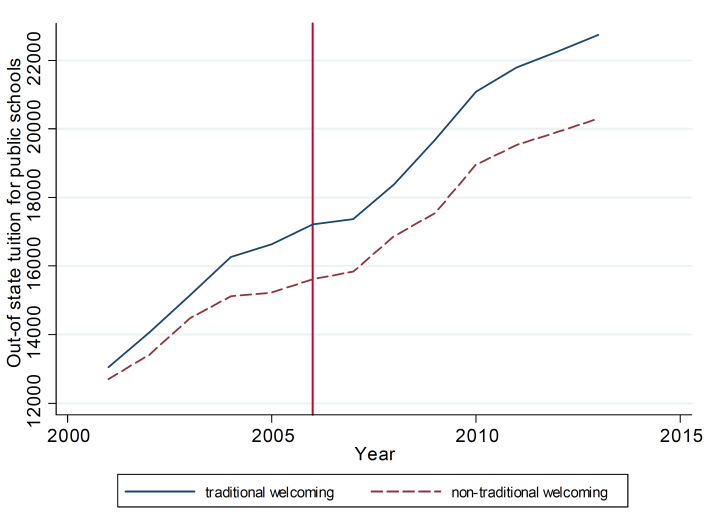
Notes: See notes for Figure 2. I split the sample into two groups. Traditional welcoming institutions are schools that had more than 85 full-time first-time foreign students between 1998 and 2000, and non-traditional welcoming institutions are the residual group.

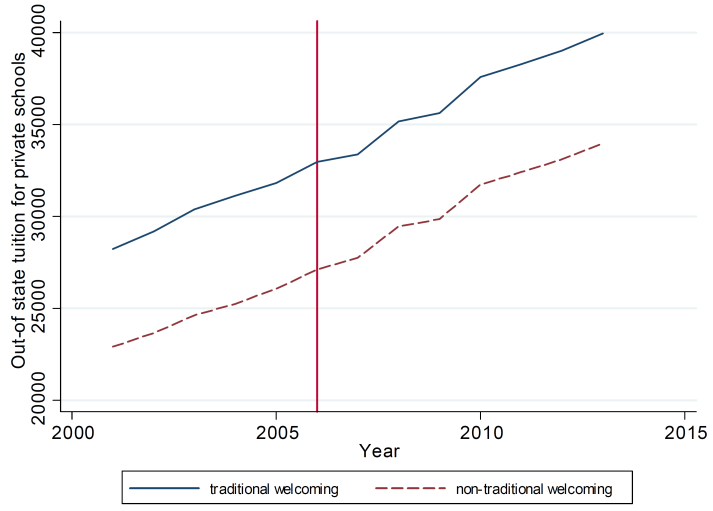
Figure 4: Tuition, By Type Of Institutions, 2001-2013

(a) In-state Tuition For Public Schools



(b) Out-of State Tuition For Public Schools



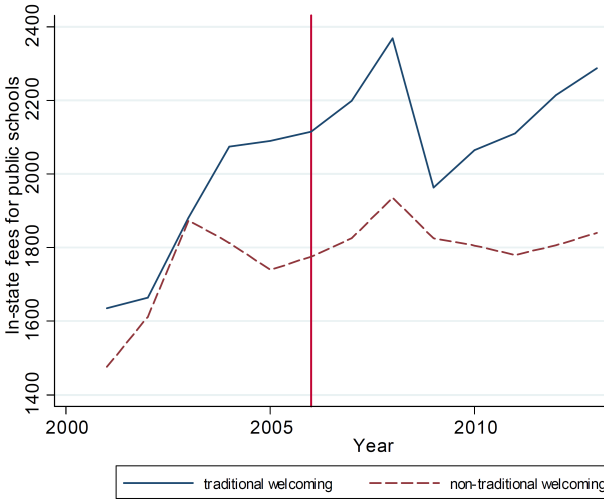


(c) Out-of State Tuition For Private Schools

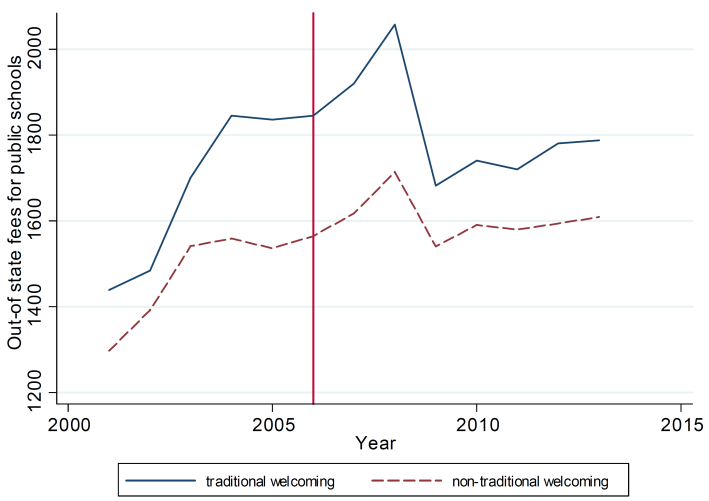
Notes: See notes for Figure 3. Tuition are dollars and are deflated by the Consumer Price Index (CPI).CPI adjustments such that 100=2013.

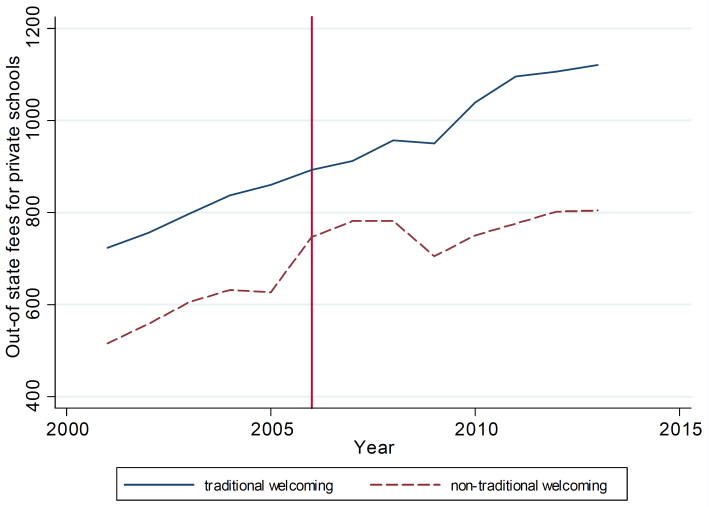
Figure 5: Fees, By Type Of Institutions, 2001-2013

(a) In-state Fees For Public Schools



(b) Out-of State Tuition For Public Schools



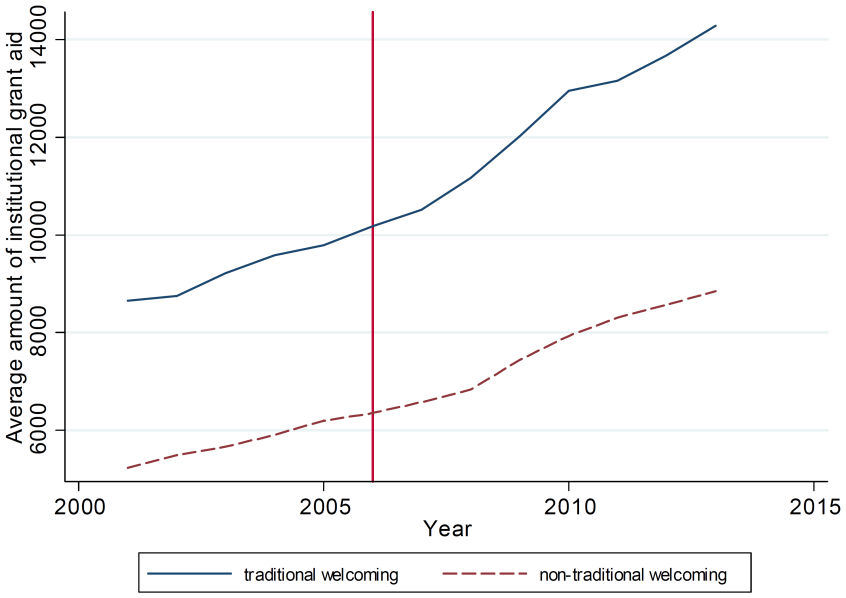


(c) Out-of State Tuition For Private Schools

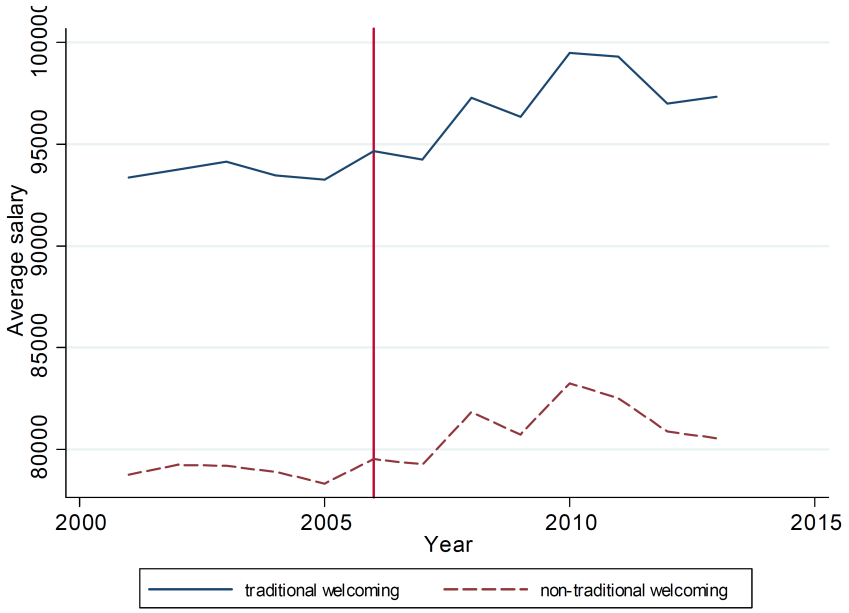
Notes: See notes for Figure 3. Fees are dollars and are deflated by the Consumer Price Index (CPI).CPI adjustments such that 100=2013.

Figure 6: Institutional Grant Aid and Average Salary, By Type Of Institutions, 2001-2013

(a) Average amount of institutional grant aid, by type of institutions



(b) Average salary for equated 9 month full-time instructional staff



Notes: See notes for Figure 2. Average salary for equated 9 month full-time instructional staff are dollars and are deflated by the Consumer Price Index (CPI).CPI adjustments such that 100=2013.

Figure 7: Suppy And Demand For Education

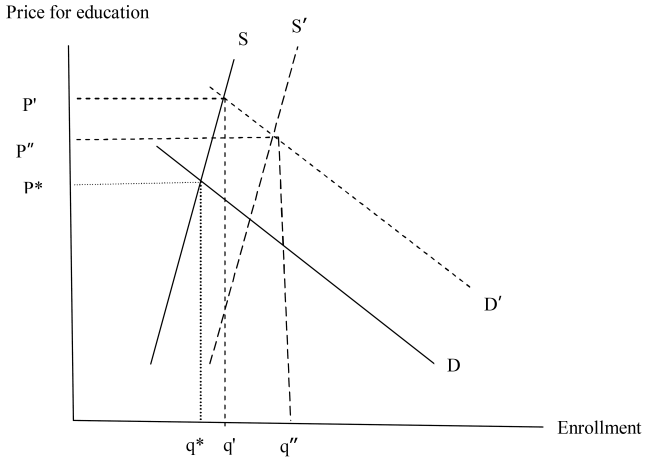


Figure 8: Number of foreign students by major, 2002-2012

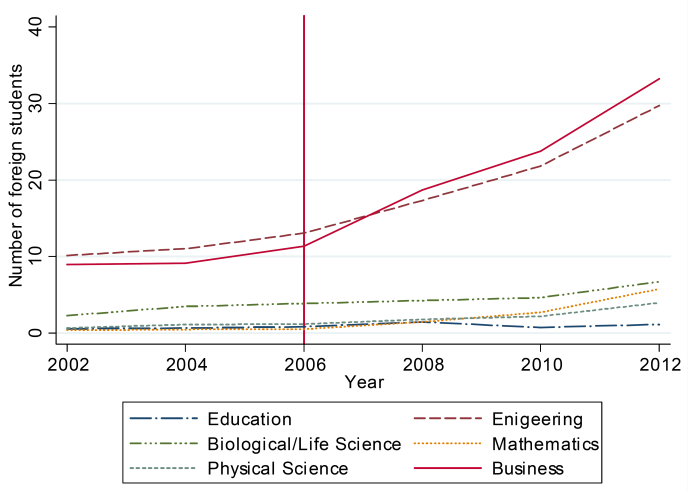


Table 1: Summary Statistics

	Overall (1)	*2001-2005* (2)	*2006-2013* (3)
Grand total	2546.762	2381.175	2650.254
	(1681.774)	(1583.007)	(1733.035)
Nonresident alien total	79.653	48.686	99.008
	(121.177)	(52.826)	(145.421)
In-state tuition in public schools	5805.311	4513.984	6612.391
	(2974.707)	(2490.251)	(2968.967)
Out-of state tuition in public schools	17287.45	14573.31	18983.79
	(6098.872)	(4378.611)	(6402.914)
Out-of state tuition in private schools	31933.11	28063.17	34351.82
	(8334.68)	(7045.653)	(6896.774)
In-state fees in public schools	1643.567	1554.109	1699.477
	(1747.434)	(1716.431)	(1764.89)
Out-of state fees in public schools	1902.786	1778.681	1980.351
	(2490.348)	(2303.481)	(2598.19)
Out-of state fees in private schools	842.666	718.221	920.444
	(848.917)	(767.822)	(887.610)
Average amount of institutional grant aids	9044.508	7897.67	10001.32
	(7906.714)	(6804.5)	(8630.872)
Average salary for full-time instructional staff	88197.52	89946.57	89272.13
	(18495)	(16970.13)	(19030.36)

*Notes:*The sample only consists of research institutions. Based on Carnegie Classification 2010, research universities refer to Doctoral/Research universities (Extensive) and Doctoral/Research universities (Intensive). Enrollment variables are the number of first-time full time undergraduate students. Tuition, fees, institutional grant aids and average salary variables are dollars and are deflated by the Consumer Price Index (CPI).CPI adjustments such that 100=2013. Tuition and fees are for full-time undergraduates; average institutional grant aid are for full-time first-time undergraduates; average salary for full-time instructional staff is equated to 9 months.

Table 2: First Stage Results, 2001-2013

Dependent variable: the number of foreign undergraduates	*All Schools* (1)	*Public* (2)	*Private* (3)	*Small* (4)	*Median* (5)	*Large* (6)	*Higher Ranking* (7)	*Lower Ranking* (8)
$Before * 2006$	.0654***	.0715***	.0595**	.0345	.0348	.0820***	.0757***	.0057
	(.0185)	(.0271)	(.0251)	(.0258)	(.0224)	(.0295)	(.0244)	(.0235)
$Before * 2007$	.0973***	.0849**	.1153***	.0731**	.0440	.1118***	.1107***	-.0015
	(.0256)	(.0382)	(.0335)	(.0323)	(.0456)	(.0362)	(.0282)	(.0445)
$Before * 2008$	.1611***	.1813**	.1458***	.1044**	.0406	.2003***	.1631***	.0302
	(.0402)	(.0720)	(.0365)	(.0445)	(.0569)	(.0536)	(.0419)	(.0709)
$Before * 2009$	.2526***	.2857***	.2248***	.1124**	.0527	.3373***	.2602***	.0471
	(.0637)	(.1091)	(.0616)	(.0526)	(.0862)	(.0828)	(.0707)	(.1077)
$Before * 2010$	.3176***	.4237***	.2065**	-.0015	.0363	.4737***	.3402***	.0256
	(.0797)	(.1309)	(.0850)	(.0654)	(.0647)	(.1087)	(.0955)	(.0970)
$Before * 2011$	.4775***	.6295***	.3232***	.0255	.0904	.6983***	.5240***	.0393
	(.1411)	(.2374)	(.0932)	(.0857)	(.0981)	(.1970)	(.1821)	(.1258)
$Before * 2012$	.5205***	.6717***	.3786***	.2498***	.1008	.6708***	.4794***	.2283
	(.1149)	(.2016)	(.1127)	(.0720)	(.1189)	(.1535)	(.1355)	(.1981)
$Before * 2013$	.5569***	.6649***	.4697***	.2596***	.1146	.7065***	.4774***	.3004
	(.1230)	(.2100)	(.1400)	(.0609)	(.1274)	(.1692)	(.1437)	(.2379)
Cragg-Donald Wald F statistic	74.32	52.51	48.56	15.34	2.84	30.73	21.52	14.78
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of universities	246	162	84	86	80	80	100	146
Number of observations	3,198	2,106	1,092	1,118	1,040	1,040	1,300	1,898

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. "Small schools" are universities enrolled less than 4,000 students during 1998 and 2000; "Median schools" are universities enrolled between 4,000 and 8,000 students during 1998 to 2000; "Large schools" are universities enrolled more than 8,000 students during 1998 to 2000. "Higher ranking" are schools whose ranking are below 100; "Lower ranking" are schools whose ranking are above 100 or have no ranking. Rankings come from the US News 2015 college rankings. *** P<0.01 ** P<0.05 * P<0.1

Table 3: Effects on Domestic Student Enrollment, 2001-2013

Dependent variable: the number of domestic undergraduates	*All Schools* (1)	*Public* (2)	*Private* (3)	*Large* (4)	*Higher Ranking* (5)
Number of foreign students	-.5661	-.0962	-.7202	-1.0482*	-1.3331**
	(.4731)	(.7149)	(.5728)	(.5569)	(.5389)
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Number of universities	246	162	84	80	100
Number of observations	3,198	2,106	1,092	1,040	1,300

Notes: See notes for Table 2. *** P<0.01 ** P<0.05 * P<0.1

Table 4: Effects on Institutional Outcomes, 2001-2013

	In-state tuition in public schools (1)	*Out-of state tuition in public schools* (2)	*Out-of state tuition in private schools* (3)	*In-state fees in public schools* (4)
Number of foreign students	4.0514*	11.2033**	.8775	.2015
	(2.220)	(5.2416)	(4.2041)	(.9785)
Year fixed effects	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y
Number of universities	162	162	84	162
Number of observations	2,106	2,106	1,092	2,106

	Out-of state fees in public schools (5)	*Out-of state fees in private schools* (6)	*Institutional grant aid* (7)	*Average salary for instructional staff* (8)
Number of foreign students	1.1241	.9114	13.2168**	13.6336**
	(1.6897)	(.9217)	(6.2006)	(6.0387)
Year fixed effects	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y
Number of universities	84	84	246	246
Number of observations	1,092	1,092	3,195	3,198

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. Tuition, fees, institutional grant aid and average salary for equated 9 month instructional staff are dollars and are deflated by the Consumer Price Index (CPI). CPI adjustments such that 100=2013. *** P<0.01 ** P<0.05 * P<0.1

Table 5: Robustness Checks: Excluding Ten Large Universities, 2001-2013

	Number of domestic students (large) (1)	*Number of domestic students (higher ranking)* (2)	*In-state tuition in public schools* (3)	*Out-of state tuition in public schools* (4)	*Out-of state tuition in private schools* (5)
Number of foreign students	.2349	-.5171	5.3499***	13.0969***	1.6259
	(.5250)	(.6667)	(1.9336)	(4.5367)	(12.3371)
Cragg-Donald F statistic in the first stage	25.87	14.03	72.38	72.38	12.26
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Number of universities	73	91	158	158	78
Number of observations	949	1,183	2,054	2,054	1,014

	In-state fees in public schools (6)	*Out-of state fees in public schools* (7)	*Out-of state fees in privte schools* (8)	*Institutional grant aid* (9)	*Average salary for instructional staff* (10)
Number of foreign students	-.1163	1.2600	1.0389	13.6368**	14.6783*
	(1.1804)	(2.0294)	(1.6165)	(5.4194)	(7.9405)
Cragg-Donald F statistic in the first stage	72.38	72.38	12.26	64.63	64.63
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Number of universities	158	158	78	236	236
Number of observations	2,054	2,054	1,014	3,065	3,068

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. I exclude 10 universities that have the largest number of foreign students between 1998 and 2000. Tuition, fees, institutional grant aids and average salary for equated 9 month instructional staff are dollars and are deflated by the Consumer Price Index (CPI). CPI adjustments such that 100=2013. *** P<0.01 ** P<0.05 * P<0.1

Table 6: Robustness Checks: Adding Institution-specific Linear Year Trends, 2001-2013

	Number of domestic students (large) (1)	*Number of domestic students (higher ranking)* (2)	*In-state tuition in public schools* (3)	*Out-of state tuition in public schools* (4)	*Out-of state tuition in private schools* (5)
Number of foreign students	-1.3527***	-.3453	5.6825***	8.3461**	6.7113**
	(.3334)	(.3056)	(1.5565)	(2.2949)	(3.1510)
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Institution-specific linear year trends	Y	Y	Y	Y	Y
Number of universities	80	100	162	162	84
Number of universities	1,040	1,300	2,106	2,106	1,092

	In-state fees in public schools (6)	*Out-of state fees in public schools* (7)	*Out-of state fees in privte schools* (8)	*Institutional grant aid* (9)	*Average salary for institutional staff* (10)
Number of foreign students	-2.5751**	-2.9933**	.1501	.9696	2.3426
	(1.1163)	(1.2859)	(.3196)	(1.1522)	(2.2565)
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Institution-specific linear year trends	Y	Y	Y	Y	Y
Number of universities	162	162	84	246	246
Number of universities	2,106	2,106	1,096	3,195	3,198

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. In each specification, I include state-specific year trends. Tuition, fees, institutional grant aids and average salary for equated 9 month instructional staff are dollars and are deflated by the Consumer Price Index (CPI). CPI adjustments such that 100=2013. *** P<0.01 ** P<0.05 * P<0.1

Table 7: Robusness Check: Effects on Applications, 2001-2013

Dependent variables: the number of applications	*All Schools* (1)	*Public* (2)	*Private* (3)	*Small* (4)	*Median* (5)	*Large* (6)	*Higher Ranking* (7)	*Lower Ranking* (8)
$Before * 2006$	2.6960**	-.3510	5.3492***	6.8059***	2.9066	.73846	2.2539	-1.5359
	(1.1401)	(1.1956)	(1.7735)	(2.2117)	(3.0664)	(1.3210)	(1.4211)	(2.1613)
$Before * 2007$	6.5120***	5.1759***	7.2116***	12.0019***	9.0708***	1.7978	2.8507	7.5560**
	(1.5918)	(1.9119)	(2.3704)	(2.7037)	(3.1846)	(1.6056)	(1.7698)	(2.9329)
$Before * 2008$	8.8292***	7.2905***	10.0273***	13.2702***	9.3253**	3.8558*	5.3353***	7.7531***
	(1.6707)	(1.6118)	(2.9915)	(2.7083)	(3.5746)	(1.9722)	(2.0316)	(2.7852)
$Before * 2009$	9.5159***	7.1473***	11.3433***	10.1549**	12.9234**	3.0848	4.6917*	9.5997**
	(2.3655)	(2.4397)	(3.6798)	(4.5531)	(5.6952)	(2.4756)	(2.7922)	(3.9468)
$Before * 2010$	12.1401***	8.6790***	14.9276***	13.8561**	17.1623**	4.5811*	7.2960**	10.4857**
	(2.6993)	(2.3479)	(4.6654)	(5.6535)	(6.8515)	(2.3576)	(3.0607)	(5.2269)
$Before * 2011$	14.7988***	11.1433***	17.2555***	16.4916***	19.5428***	6.8796**	8.7098**	12.9225**
	(3.1771)	(3.3802)	(5.0376)	(6.2462)	(6.9961)	(3.4391)	(3.6639)	(6.1151)
$Before * 2012$	15.7537***	11.8201***	18.672***	19.4350**	17.1661***	8.7189**	10.2527***	10.5055*
	(3.1747)	(3.7202)	(4.6182)	(8.3740)	(6.2090)	(3.7464)	(3.7235)	(5.7648)
$Before * 2013$	18.4538***	14.9532***	21.2314***	22.6017***	19.1549***	10.0316**	11.6010**	10.4255*
	(3.7586)	(4.9946)	(4.9020)	(7.9174)	(6.8634)	(4.7985)	(4.4949)	(5.7122)
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of universities	246	162	84	86	80	80	100	146
Number of observations	3,113	2,037	1,076	1,118	1,013	1,021	1,300	1,898

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. "Small schools" are universities enrolled less than 4,000 students during 1998 and 2000; "Median schools" are universities enrolled between 4,000 and 8,000 students during 1998 to 2000; "Large schools" are universities enrolled more than 8,000 students during 1998 to 2000. "Higher ranking" are schools whose ranking are below 100; "Lower ranking" are schools whose ranking are above 100 or have no ranking. Rankings come from the US News 2015 college rankings. *** P<0.01 ** P<0.05 * P<0.1

Table 8: Robusness Check: Effects on the Influx of Foreign Graduate Students, 2001-2013

Dependent variables: the number of foreign graduate students	*All Schools* (1)	*Public* (2)	*Private* (3)	*Small* (4)	*Median* (5)	*Large* (6)	*Higher Ranking* (7)	*Lower Ranking* (8)
$Before * 2006$	.0167**	.0009	.0388***	.0257**	.0471***	.0098	.0188**	-.0117
	(.0070)	(.0061)	(.0092)	(.0121)	(.0135)	(.0096)	(.0088)	(.0106)
$Before * 2007$	.0288***	.0106	.0543***	.0470***	.0659***	.0172	.0292**	.0166
	(.0097)	(.0102)	(.0114)	(.0176)	(.0134)	(.0144)	(.0123)	(.0157)
$Before * 2008$	.0350***	.0133	.0655***	.0703***	.0609***	.0198	.0365**	.0165
	(.0130)	(.0149)	(.0148)	(.0223)	(.0152)	(.0197)	(.0167)	(.0185)
$Before * 2009$	.0584***	.0296*	.0987***	.0920***	.0861***	.0444*	.0617***	.0223
	(.0162)	(.0173)	(.0196)	(.0342)	(.0130)	(.0255)	(.0209)	(.0181)
$Before * 2010$	.0709***	.0403**	.1137***	.1245***	.0993***	.0495*	.0678***	.0403*
	(.0180)	(.0192)	(.0215)	(.0371)	(.0139)	(.0276)	(.0235)	(.0242)
$Before * 2011$	.0878***	.0519**	.1380***	.1518***	.1239***	.0624**	.0820***	.0517*
	(.0202)	(.0210)	(.0231)	(.0432)	(.0161)	(.0299)	(.0265)	(.0299)
$Before * 2012$	.1206***	.0790***	.1788***	.2006***	.1463***	.0966**	.1127***	.0813**
	(.0241)	(.0249)	(.0292)	(.0456)	(.0207)	(.0380)	(.0316)	(.0351)
$Before * 2013$	.1466***	.0999***	.2119***	.2427***	.1605***	.1220***	.1350***	.1338***
	(.0281)	(.0262)	(.0393)	(.0542)	(.0215)	(.0449)	(.0367)	(.0443)
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of universities	246	162	84	86	80	80	100	146
Number of observations	3,113	2,037	1,076	1,118	1,013	1,021	1,300	1,898

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. "Small schools" are universities enrolled less than 4,000 students during 1998 and 2000; "Median schools" are universities enrolled between 4,000 and 8,000 students during 1998 to 2000; "Large schools" are universities enrolled more than 8,000 students during 1998 to 2000. "Higher ranking" are schools whose ranking are below 100; "Lower ranking" are schools whose ranking are above 100 or have no ranking. Rankings come from the US News 2015 college rankings. *** P<0.01 ** P<0.05 * P<0.1

Table 9: Robustness Checks: Triple Difference Design

	Number of foreign students (1)	*Number of domestic students* (2)	*Number of foreign students (large schools)* (3)	*Number of domestic students (large schools)* (4)	*Number of foreign students (higher ranking)* (5)
$Before * Post2006 * Major$	.0016		-.0021		.0003
	(.0090)		(.0121)		(.0111)
$Before * Post2008 * Major$	.0175**		.0179*		.0152*
	(.0071)		(.0094)		(.0089)
$Before * Post2010 * Major$	.0447***		.0570***		.0468***
	(.0082)		(.0114)		(.0106)
$Before * Post2012 * Major$	.0674***		.0805***		.0627***
	(.0121)		(.0163)		(.0148)
Cragg-Donald F statistic	40.37		17.71		9.75
Number of foreign students		-.4423		-.7081	
		(.3803)		(.4600)	
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Institution-shock fixed effects	Y	Y	Y	Y	Y
Institution-major fixed effects	Y	Y	Y	Y	Y
Major-shock fixed effects	Y	Y	Y	Y	Y
Number of universities	237	237	80	80	100
Number of observations	6,892	6,892	2,514	2,514	2,330

Notes: See notes for Table 2. Standard errors are reported in parentheses and are clustered at the institutional-year level. $Major$ equals one if students are enrolled in business, engineering, mathematics or physical science. *Shock* equals one if the year is equal or after 2006.*** P<0.01 ** P<0.05 * P<0.1

Table 10: Robustness Checks: Alternative Instrumental Variable (IV)

	Number of domestic students (large) (1)	*Number of domestic students (higher ranking)* (2)	*In-state tuition in public schools* (3)	*Out-of state tuition in public schools* (4)	*Out-of state tuition in private schools* (5)
Number of foreign students	-1.0908*	-1.4560**	4.0723*	11.6882**	.9785
	(.5897)	(.5922)	(2.1227)	(5.2251)	(4.0544)
F statistic in the first stage	17.89	10.56	9.48	9.48	10.82
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Number of universities	80	100	162	162	84
Number of observations	1,040	1,300	2,106	2,106	1,092

	In-state fees in public schools (6)	*Out-of state fees in public schools* (7)	*Out-of state fees in privte schools* (8)	*Institutional grant aid* (9)	*Average salary for instructional staff* (10)
Number of foreign students	.2744	1.2989	.9492	13.8925**	14.0631**
	(.9434)	(1.6830)	(.9000)	(6.0678)	(5.9938)
F statistic in the first stage	9.48	9.48	10.82	17.97	17.97
Year fixed effects	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y
Number of universities	162	162	84	246	246
Number of observations	2,106	2,106	1,096	3,195	3,198

Notes: Standard errors are reported in parentheses and are clustered at the institutional level. Tuition, fees, institutional grant aids and average salary for equated 9 month instructional staff are dollars and are deflated by the Consumer Price Index (CPI). CPI adjustments such that 100=2013. *** P<0.01 ** P<0.05 * P<0.1

Table 11: First Stage Results: Adding Institution Specific Linear Year Trend, 2001-2013

Dependent variable: the number of foreign undergraduates	*All Schools* (1)	*Public* (2)	*Private* (3)	*Small* (4)	*Median* (5)	*Large* (6)	*Higher Ranking* (7)	*Lower Ranking* (8)
$Before * 2006$	.0392**	.0546*	.0215	.0522**	-.0052	.0537**	.0328	.0451*
	(.0188)	(.0300)	(.0195)	(.0246)	(.0264)	(.0235)	(.0243)	(.0231)
$Before * 2007$	.0623**	.0624	.0647**	.0968***	-.0093	.0741**	.0535*	.0510
	(.0267)	(.0444)	(.0277)	(.0347)	(.0232)	(.0308)	(.03220	(.0411)
$Before * 2008$	.1174***	.1531*	.0826*	.1340***	-.0261	.1531***	.0916*	.0959*
	(.0449)	(.0812)	(.0433)	(.0284)	(.0318)	(.0355)	(.0541)	(.0561)
$Before * 2009$	.2002***	.2519**	.1489**	.1479***	-.0274	.2807***	.1744**	.1260
	(.0671)	(.1157)	(.0662)	(.0368)	(.0436)	(.0319)	(.0824)	(.0913)
$Before * 2010$	.2565***	.3843***	.1179	.0398	-.0571	.4077***	.2402**	.1176
	(.0871)	(.1433)	(.0937)	(.1030)	(.0548)	(.0495)	(.1102)	(.1017)
$Before * 2011$	.4077***	.5844**	.2220*	.0728	-.0164	.6229***	.4097**	.1444
	(.1475)	(.2411)	(.1201)	(.1253)	(.0584)	(.1382)	(.1981)	(.1286)
$Before * 2012$	.4420***	.6211***	.2648**	.3031***	-.0193	.5859***	.3509**	.3465*
	(.1282)	(.2253)	(.1316)	(.0573)	(.0937)	(.0714)	(.1603)	(.1835)
$Before * 2013$	.4696***	.6086**	.3432**	.3187***	-.0189	.6122***	.3345*	.4318*
	(.1408)	(.2397)	(.1614)	(.0686)	(.0988)	(.0786)	(.1745)	(.2266)
Cragg-Donald Wald F statistic	23.17	21.85	10.28	14.1	0.72	10.41	6.42	17.87
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Institution fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Institution specific linear year trend	Y	Y	Y	Y	Y	Y	Y	Y
Number of universities	246	162	84	86	80	80	100	146
Number of observations	3,198	2,106	1,092	1,118	1,040	1,040	1,300	1,898

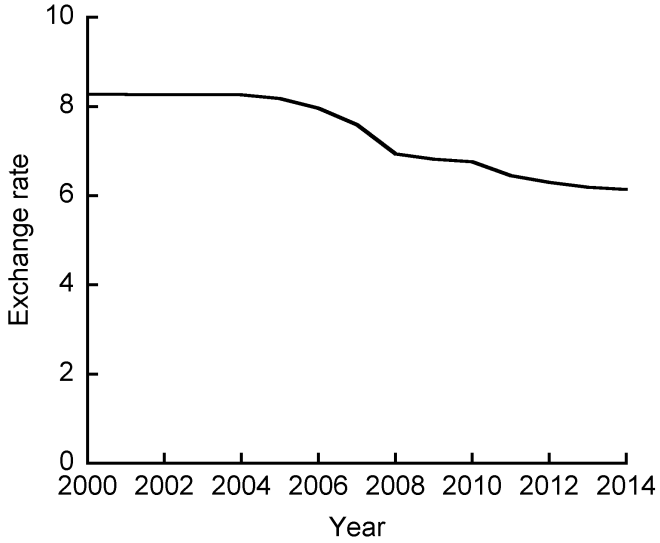
Notes: Standard errors are reported in parentheses and are clustered at the institutional level. "Small schools" are universities enrolled less than 4,000 students during 1998 and 2000; "Median schools" are universities enrolled between 4,000 and 8,000 students during 1998 to 2000; "Large schools" are universities enrolled more than 8,000 students during 1998 to 2000. *** P<0.01 ** P<0.05 * P<0.1

Table 12: Robustness Checks: Placebo Tests, 2001-2006

	Number of foreign students (1)	*Number of foreign students* (2)	*Number of foreign students* (3)
Before	.0087		
	(.0056)		
*Before*2003*			.0057
			(.0147)
*Before*2004*		.0053	.0072
		(.0207)	(.0229)
*Before*2005*		.0474**	.0493**
		(.0219)	(.0222)
Year fixed effects	Y	Y	Y
Institution fixed effects	Y	Y	Y
State fixed effects	Y	Y	Y
Number of universities	246	246	246
Number of observations	1,230	1,230	1,230

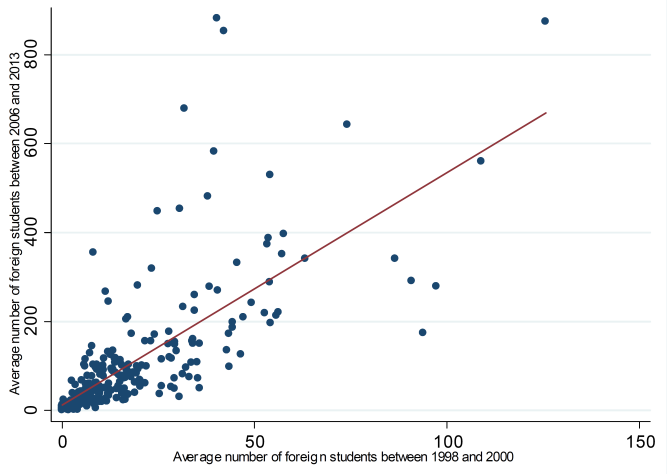
Notes: Standard errors are reported in parentheses and are clustered at the institutional level. I only include prior shock periods observations. In Column (1), I run Equation (6); in Column (2) and Column (3), I run Equation (2) by moving the shock year from 2006 to 2003 and 2004, respectively. *** P<0.01 ** P<0.05 * P<0.1

Figure 9: Number Of Chinese And International Students In American Institutions, 2000-2013



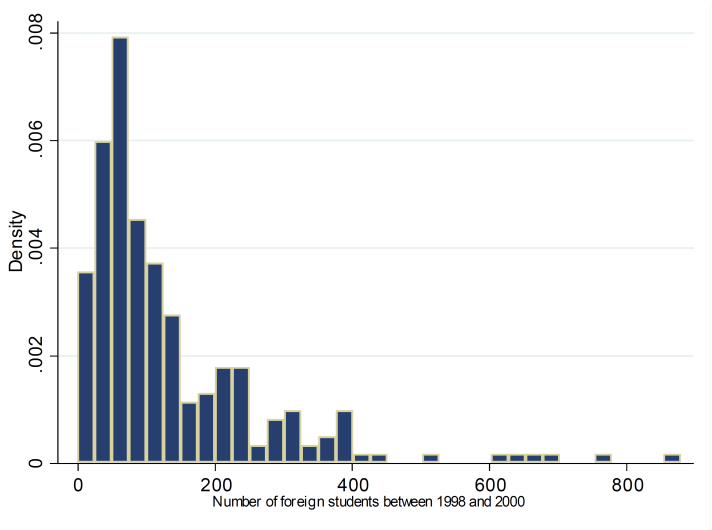
Notes: source: http://www.oanda.com/lang/cns/currency/historical-rates/

Figure 10: The numbers of full-time first-time foreign students before and after the shock



Notes: Data is collected from the Integrated Postsecondary Education Data System (IPEDS). Based on Carnegie Classification 2010, research universities refer to Doctoral/Research universities (Extensive) and Doctoral/Research universities (Intensive).

Figure 11: The distribution of the number of foreign students between 1998 and 2000 across universities



Notes: Data is collected from the Integrated Postsecondary Education Data System (IPEDS). Based on Carnegie Classification 2010, research universities refer to Doctoral/Research universities (Extensive) and Doctoral/Research universities (Intensive).

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