

**College in the States: Foreign Student Demand and Higher Education
Supply in the U.S.**

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The U.S. is increasingly a destination for college students from abroad. While it is well-known that the representation of foreign doctorate students at U.S. universities, particularly in science and engineering fields, has increased dramatically over the last three decades, the growth in the participation of undergraduate students is less well-understood. In this paper, we trace out the notable increase in enrollment from abroad, largely as full-pay students, at colleges and universities. Countries in which incomes have expanded rapidly in recent decades have demonstrated the most appreciable growth in undergraduate enrollment at U.S. universities. We model variation over time in the foreign undergraduate enrollment in the U.S. in terms of costs, home country opportunities, and incomes. In addition, we examine the supply-side accommodation in the U.S. to changes in demand from abroad and find that adjustments are particularly marked in those states and institutions where local demand is most likely relatively weak.

I. Introduction

One expert on education policy recently noted, “There are two things that the USA unambiguously does better than any other place in the world -- Hollywood movies and higher education.”¹ Without taking a stand on the cultural contribution of Hollywood, it is unambiguously clear that the U.S. has a disproportionate share of the most resource-intensive colleges and universities in the world. Based on rankings of research universities, 6 of the top 10 universities and 15 of the top 30 universities are located in the U.S.² In addition, the U.S. is home to a large number of private liberal arts colleges which offer top-tier undergraduate opportunities, often regarded as on par with many of the best research universities. Thus, it should be no surprise that U.S. undergraduate education is in high demand from students around the world. Notably, the number of foreign students in the undergraduate population at U.S. colleges and universities has increased markedly in recent years, from 288,000 in 2000 to 422,300 in 2011.³ This translates to a 6.8% increase in the share of foreign students in the undergraduate population, from 2.19% to 2.34%. Moreover, this trend is more marked at the most prestigious U.S. colleges and universities: the share of foreign students increased by 29% at state flagships, 42% at top 25 research universities, and 41% at top 25 liberal arts colleges between 2000 and 2010.⁴ Our objective in this paper is to understand how demand factors from different countries abroad, determine the flow of undergraduate students to the U.S.

The flow of temporary residents to undergraduate programs in the U.S. is important for several reasons. First, higher education is “big business”, representing a substantial service export. During the 2011-2012 academic year, international students and their dependents contributed an estimated \$21.8

¹ David Figlio, personal correspondence.

² Source: *U.S. News World’s Best Universities* rankings, 2012.

³ Source: *Digest of Education Statistics 2012*, Table 263.

⁴ Source: The Integrated Postsecondary Education Data System (IPEDS). “Top 25 research universities” and “Top 25 liberal arts colleges” based on U.S. News Rankings from 2012. We exclude the United States Military Academy and the United States Naval Academy from the list of top 25 liberal arts colleges.

billion to the U.S. economy.⁵ The impact of foreign participation is particularly marked in cities and towns with large concentrations of colleges and universities. For example, Allan Goodman of the Institute of International Education (IIE) notes “These are foreign people buying an American product and the Department of Commerce says international education is our fifth-largest service export, bigger than medical services. It’s a huge factor in a lot of cities, including New York, where international students contribute about \$1.5 billion, more than the Yankees, Mets and Giants combined.”⁶ The economic impact of these students extends beyond tuition dollars to other goods and services purchased in local economies. In addition, foreign students may have a substantial impact on the U.S. labor market, particularly in science and engineering fields, as study in the U.S. may provide an option value to employment and increase the supply of highly-skilled workers to the U.S. economy, particularly in science, technology, engineering, and mathematics (STEM) fields (Rosenzweig, 2006). For example, among temporary residents with a BA degree working in science and engineering fields, nearly 52% received their degrees from in the U.S.⁷ The increased flow of foreign students to U.S. colleges and universities raises questions of crowd-out, as these students may reduce academic opportunities for natives while also placing downward pressure on wages in the labor market.⁸ While we do not address the issue of crowd-out in this paper, it is still a strong motivation for understanding the basics of the flow of foreign undergraduates to the U.S.

To be sure, “internationalization” is nothing new to higher education.⁹ The representation of foreign doctorate students at U.S. universities, particularly in science and engineering fields, has

⁵ NAFSA: Association of International Educators. NAFSA computes economic impact using foreign enrollment data from the Institute of International Education’s Open Doors Report and tuition and living cost estimates from Wintergreen Orchard House.

⁶ Quoted in Lewin, 2007.

⁷ Source: NSF Science and Engineering Indicators 2010, Table 3-25.

⁸ Borjas (2004) finds evidence of crowd out in graduate programs among white native men. However, we regard the question of crowd out in undergraduate education as unresolved. Bird and Turner (2013) do not find evidence of crowd out and suggest a model in which additional full pay foreign students increase a college’s capacity to enroll low- and moderate-income domestic students.

⁹ Bound, Turner, and Walsh (2009) describe trends in and determinants of demand from foreign students to U.S. doctoral programs.

increased dramatically over the last three decades, rising from 16% in 1981 to 34% in 2011.¹⁰ However, foreign participation in U.S. undergraduate education is notably distinguished from participation in advanced degree programs. Foreign-born undergraduates are a much smaller share of the overall population of undergraduates in the U.S. – even though the share of foreign students has grown in the past two decades, it is still less than 3%. Even so, there are a set of institutions where temporary residents account for more than 15% of undergraduate enrollment, ranging from Oklahoma City University to Northeastern University. In addition, foreign undergraduates are much more likely to be “full-pay” students compared to students in doctoral programs. This difference in who pays not only impacts who comes to study in the U.S., but also the market dynamics of how changes in demand from abroad are accommodated in the U.S. market.¹¹

In this paper, we begin by discussing the somewhat limited research on the flow of foreign students to the U.S. in Section II. We then describe the trends in undergraduate enrollment among foreign students at U.S. colleges and universities in Section III. In Section IV, we discuss determinants of foreign student demand, and then provide estimates of the demand-side determinants of enrollment using variation by country and year. In Section V, we examine how economic factors at home affect the supply of seats to foreign students. Our results make clear the strong economic explanations for decisions among foreign students to pursue undergraduate studies in the United States. Exchange rate fluctuations, home country income, and home country population of potential undergraduates are all highly related with changes in foreign enrollment at U.S. undergraduate programs, results which are in large part driven by China.

¹⁰ Source: Survey of Earned Doctorates, National Science Foundation.

¹¹ For example, with a tuition price clearing the market, students from low-income countries and low-income families will be relatively constrained in their access to U.S. undergraduate education. In addition, demand from tuition paying students, including those from abroad may allow higher education institutions to expand or to provide an additional resources for instruction or financial aid.

II. Prior Research

While there is an established literature on high-skilled immigration (see Kerr, 2013 for a discussion of the literature), there is limited existing work on determinants of foreign student flows into the U.S. higher education system. Notable exceptions often focus on graduate-level students or aggregate undergraduate and graduate students into one measure of foreign enrollment. Bound, Turner, and Walsh (2009) explore the enrollment trends of foreign doctoral students in the U.S. They provide descriptive evidence to support two hypotheses: first, that countries with fewer domestic doctoral program options will send relatively higher numbers of students to U.S. doctoral programs; and second, that countries with a larger share of its' doctoral students attending programs in the U.S. will send students to relatively lower quality U.S. doctoral programs. The economic reasoning behind these findings is clear: students from countries with fewer options for high-quality graduate study, such as China, face a smaller opportunity cost than students from countries such as Canada or the U.K., which have many of their own top-tier research universities. However, as we show in this paper, enrollment decisions of graduate versus undergraduate students are quite different. As Bound, Turner, and Walsh point out, most doctoral students are fully funded through assistantships or fellowships. In addition, 47% percent of U.S. doctorate recipients received their undergraduate degree outside the U.S., indicating that students who come to the U.S. for undergraduate study are only a small intersection of the foreign doctoral population (Bound and Turner, 2013).

A few papers explore motivations for foreign students coming to study in the United States. Rosenzweig (2006) proposes two models for foreign student mobility: a “constrained domestic schooling model”, which leads to the hypothesis that foreign students seek education in the U.S. due to a dearth of home country options; and a “migration model”, which points to the hypothesis that foreign students enroll in the U.S. to increase the probability that they will find employment in the U.S. when they

graduate. Using a cross-section of data, he finds that the number of foreign students is positively related to the number of universities in a home country, and negatively related to the home country “skill-price”, the market wage for a given skill level. Rosenzweig concludes that the migration model is the correct model, meaning foreign students come to the U.S. for education for an option value to enter the U.S. labor market. However, Hwang (2009) uses a panel of data from an alternate source, and finds a positive relationship between a home country’s skill-price and enrollment in the U.S. She also performs a survey of foreign students at Harvard, from which 35.8% respondents revealed that their primary reason for studying in the U.S. was a lack of high-quality options in their home country. In addition, only half of respondents expressed the desire to work in the U.S. after graduation, and only 22% wished to work in the U.S. long term.

Rosenzweig and Hwang do not disaggregate foreign students into education levels, i.e. undergraduate versus graduate. Yet, as we discuss below, demand determinants are likely very different for undergraduate, Master’s, professional, or doctorate level students. Due to severe data constraints, the literature does not have much to say specifically regarding the decisions of foreign undergraduate students in the U.S. However, Kato and Sparber (2013) employ the same enrollment data we use in our analysis, as well as data from the College Board, which reports SAT scores sent to U.S. institutions by country of origin. They test how decreasing H1B visa quotas for most countries in the mid-2000s affected foreign enrollment. They find that not only do smaller quotas decrease foreign enrollment, but these restrictions also decrease the average quality of foreign interested in applying to U.S. institutions. Kato and Sparber’s results are consistent with the migration model proposed by Rosenzweig, as applicants become less likely to secure employment in the U.S. after graduation. However, their results may be confounded by the fact that the U.S. student visa program also suffered from additional restrictions and delays in the years following the 9/11 attacks in 2001.

We note that constrained domestic schooling models and migration models are not mutually exclusive in explaining flows to the U.S. given heterogeneity among source countries. While we do not test

hypotheses derived from migration models in this paper, we do find evidence to support a constrained domestic schooling model by showing that home country tertiary-aged population is positively associated with foreign enrollment in the U.S., a result that is especially strong for countries with a small proportion of high-quality universities to potential undergraduate students. Our results are distinguished by the inclusion of other economic factors of foreign undergraduate demand, such as relative price and home country income.

III. Trends in Foreign Undergraduate Enrollment

Over the last three decades, there have been substantial changes in not only the total number of students coming to the U.S. for undergraduate education, but also shifts in countries of origin and destination institutions. Two data sources tracking country and institutional outcomes are the primary sources for what is known about these trends. First, the U.S. Department of Education distinguishes enrollment and degrees conferred among temporary residents from U.S. citizens and permanent residents at the level of the institution, further disaggregating by level of enrollment and field of degrees. Secondly, the Institute of International Education (IIE) has conducted a survey of the internationally mobile student population since 1948, which provides counts of students by country of origin studying in the U.S. at the undergraduate and graduate levels. Unfortunately, data providing enrollment by country of origin at the institution level is not available.

Overall Trend in Foreign Enrollment

It is instructive to consider not just the overall flow of foreign students to the U.S., but also the distinct trends for undergraduate and graduate students separately. Figure 1 shows total enrollment of graduate and undergraduate students from abroad at U.S. colleges and universities from 1954 to 2011.¹² The period from 1975 to 1980 represents a substantial deviation from the broad undergraduate-graduate correlation, as the pool of undergraduates nearly doubled in about five years while graduate enrollment

¹² The year corresponds to the fall year of the academic year. For example, 1954 corresponds to the 1954/55 academic year.

increased at a much steadier pace. Two factors contribute to this early period spike: first, this was an interval when U.S. demand for private higher education dropped markedly; secondly, at a time when oil prices were spiking, students from oil-rich countries found the U.S. to be a particularly attractive destination. The annual reports from the Institute of International Education (IIE) note that nearly 60% of the increase in foreign enrollment between 1969 and 1979 was attributable to students from OPEC countries.¹³

Over the three decades since 1980, the average annual growth rate in foreign graduate enrollment has been somewhat greater at 1.9% per year than undergraduate enrollment, though since 2005 undergraduate enrollment has grown at annual pace of 4.6% compared to 2.5% for graduate enrollment. Still, while foreign undergraduates represent a relatively small share of undergraduate enrollment (3.3% in our sample of 4-year public and private non-profit institutions), foreign students are a much larger share of enrollment in doctoral programs. According to the National Science Foundation's (NSF) Survey of Earned Doctorates data, 29% of all doctorate degrees awarded in 2011 went to temporary visa holders.

In the most recent decade, the post 9-11 dip is clearly evident in the time trend, and would be more marked if we were able to disaggregate by new entrants. While it is often conjectured that more stringent visa requirements amid a perceived hostile environment stifled foreign enrollment after 9/11, there is some evidence that the decline started before 9/11 and largely reflects a response to contracting economic opportunities.¹⁴ Still, in the period since the collapse of the financial markets in 2008, enrollment of foreign students in U.S. higher education has continued on an upward trajectory, rising 14.6% in the 2008-11 interval among undergraduates and 6% among graduate students. As we show

¹³ Enrollment from OPEC countries jumped by 41% in the single year between 1976 and 1977, rising by more than 21,000 students. Of these countries, the largest increase (and eventual decline) came from Iran. The number of students from Iran increased from 13,780 in 1974 to a peak of 51,310 in 1979 and then contracted dramatically in the 1980s.

¹⁴ Recessionary conditions which limited U.S. job opportunities and continued growth in higher education abroad placed downward pressure on demand for U.S. degree programs. Lowell and Khadka (2011) document the post 9/11 decline and find a 20% decrease in F visas issued between 2001 and 2002, a more modest decline in 2003, and then a period of rebound beginning in 2004. Lowell and Khadka emphasize that, consistent with retrenchment in temporary student enrollment in the mid-1980s, visa declines are most closely aligned with changes in economic conditions, rises in real tuition costs at U.S. universities, and eroding post-degree job prospects in the U.S.

below, persistent growth is driven by countries less affected by the recent financial crisis, such as China and Saudi Arabia.

Trends by Country of Origin

The relatively steady increase in the number of undergraduate students from abroad disguises substantial variation in region and country of origin. Both politics and economics play a role in who chooses to study in the U.S. The last two decades have brought about dramatic changes in the countries of origin among undergraduate students.

Table 1 presents leading source countries for U.S. enrollment in 1993 and 2011 for undergraduate and graduate enrollment. Most recently, China leads the way with nearly 75,000 students enrolled as undergraduates, followed by South Korea (38,232) and Saudi Arabia (14,344). Including India, Canada, Vietnam, and Japan, the top 7 sending countries account for about 56% of total undergraduate foreign enrollment. This pattern of enrollment differs markedly from 1993, when Japan was the leading source country and China sent a much more modest number of students to study in the U.S. and did not crack the top 7 sending countries.

The bottom panel of Table 1 makes the same presentation for graduate enrollment. China, followed by India, has led the way sending students to the U.S. for more than two decades. We conjecture that the nature of Chinese enrollment at the graduate level has changed somewhat over time, shifting from enrollment nearly exclusively at the PhD level to enrollment dispersed between doctorate programs, MA programs and professional studies. Participation among students from Taiwan in U.S. graduate education has actually dropped dramatically (from 24,623 to 13,629), potentially reflecting some maturation in the university structure in Taiwan. Graduate enrollment of Iranian students has swung dramatically over the past half-century, with rapid rises in the 1960s and 1970s due to increased demand for technical skills, a sharp drop in entry after the 1979 Revolution, and a recent uptick that has once

again placed Iran in the top 7 senders of graduate students. Enrollment from Eastern European has also been on the rise; however, these students still represent a relatively small share of foreign graduates.¹⁵

Across countries, the trends in participation in U.S. higher education differ markedly, along with notable differences in the concentration of undergraduate and graduate students. Figure 2 and Figure 3 present time trends for selected countries. For some countries that are working up the development trajectory, such as China and India, there is some indication the growth in graduate education precedes growth in undergraduate education. We hypothesize that this occurs in part because U.S. institutions are able to offer substantial financial aid for graduate study, particularly in PhD science programs. For affluent western economies with well-developed home country education systems such as Germany and Canada, undergraduate and graduate enrollment are near the same scale and exhibit modest variation over our period of analysis.

Countries from which there has been dramatic growth in undergraduate enrollment in recent years include China, Saudi Arabia, and South Korea. As we discuss in this paper, relatively robust economic circumstances, growing college-age populations and limited home country undergraduate options are important explanatory factors. In the case of Saudi Arabia, the introduction of an explicit government fellowship for study abroad is clearly a contributing factor to the observed increase in enrollments (Kurtz, 2012).¹⁶

The case of China merits some particular discussion in that the numbers are so large and the change so dramatic over the course of the last decade. Looking back to the early 1970s, the number of students from China studying in the U.S. was trivial. During Mao's "Cultural Revolution" from 1966 to 1976, university activity was largely disrupted and many facets of universities ceased operations. Immediately thereafter, China sought to jump start its development process through access to science and

¹⁵ Bound, Turner, and Walsh (2009) describe foreign enrollment in U.S. Ph.D. programs in detail.

¹⁶ Motivated by a desire to reduce hostility in the Saudi public toward the United States after 9/11, the Saudi government began the King Abdullah Scholarship program in 2005, which has continued to expand. (<http://www.mohe.gov.sa/en/studyaboard/king-abdulla-hstages/pages/default.aspx>).

engineering technology via U.S. universities (Blanchard, Bound and Turner, 2009). Opportunities for educational exchanges were an important part of the establishment of diplomatic relations. A disproportionate share of the first wave of exchange students coming to the U.S. were related to high-level Chinese officials, including the son of Deng Xiaoping and the son of the Foreign Minister, though there was also considerable competition among U.S. universities to identify the most talented among the Chinese students (Wong, 1981). Yet, with the exception of the elites, few in the Chinese population could finance undergraduate education in the U.S., and most Chinese students were reliant on a limited number of scholarships. However, as China began to experience rapid economic growth in the late 1990s that resulted in the emergence of a middle-class, more students became able to afford an American education. The influx of Chinese undergraduate students has continued in the last decade, especially since 2006 as China fared well during the global recession. In fact, this trend has caught the attention of the popular press, with many articles published about the increase in the number of Chinese students due to increases in income and recruiting efforts made by U.S. colleges.¹⁷

Trends by Type of U.S. Institution

The distribution of foreign undergraduate students among institutions of higher education does not mirror the distribution of U.S. students. Foreign students are more likely to attend private institutions than U.S. students, with the foreign share at private institutions about 34% relative to about 28% for U.S. students.¹⁸ This is intuitive, as foreign students cannot benefit from lower in-state tuition rates enjoyed by many domestic students at public institutions. In addition, distance from home should not play as big role in institutional choice for many foreign students who have already moved into a different hemisphere for their education. Foreign students are more likely to attend relatively selective and high-resource institutions than domestic students. For example, in 2010, 24.8% of foreign students attend a member

¹⁷ See, for example, Lai (2012); Farrar (2012); Schoenberg (2012); Johnson (2011).

¹⁸ As with all subsequent analysis for U.S. institutions, our sample consists of regular, 4-year, public or not-for-profit private institutions. “Regular” institutions excludes specialized (i.e. “Art, Music, and Design”, “Theological/Bible/Religion”, etc.), tribal, and not classified institutions.

institution of the Association of American Universities (AAU) or a “Top 25” liberal arts college, compared to 11.9% of domestic students.¹⁹ Figure 4 shows the share of temporary residents by institution type. The representation of foreign students has increased most markedly at AAU universities and top liberal arts colleges, especially since 2006. Why do foreign students concentrate at higher quality institutions? The cost of attending a U.S. institution is higher for foreign students compared to domestic students, so an economic model would predict that foreign students who choose to enroll at U.S. institutions have higher expected returns from U.S. education or larger resources. Therefore, it is sensible that foreign students are, on average, higher quality and higher income than their domestic counterparts.

To provide a qualitative sense of the U.S. colleges and universities drawing substantial numbers of foreign undergraduates, Table 3 shows the colleges and universities with the largest numbers and shares of temporary residents. Among the institutions drawing the largest numbers of foreign undergraduates are large public research universities including Michigan State, Purdue, and University of Illinois-Urbana Champaign.²⁰ Institutions with large shares of foreign undergraduate students are disproportionately private colleges and universities, although there have been dramatic increases in the share of foreign students at top-tier public universities in the past two decades. For major research universities and top-tier liberal arts colleges, it is not unusual for an incoming class to be comprised of more than 10% foreign.

It is now common practice for institutions to recruit foreign students. For example, several elite colleges and universities in the Boston area have increased recruiting efforts in recent years (Schworm, 2008). In addition, smaller and less well known colleges are trying to raise interest in their undergraduate

¹⁹ According to their website, “The Association of American Universities (AAU) is an association of 62 leading public and private research universities in the United States and Canada. Membership in AAU is by invitation and is based on the high quality of programs of academic research and scholarship and undergraduate, graduate, and professional education in a number of fields, as well as general recognition that a university is outstanding by reason of the excellence of its research and education programs.” (www.aau.edu/about)

²⁰ Fort Hays State University, a modestly sized university in western Kansas, reports a large number and share of international students. However, the vast majority of their international students are enrolled in online courses through a partnership with Chinese universities and do not physically reside in the U.S. (<http://www.fhsu.edu/osp/international-partnerships/>)

programs among foreign students. Farrar (2012) examines the recruiting efforts of small religious colleges, such as Samford University, to recruit Chinese students. These colleges cite both a desire for global community on campus, as well as Chinese students' ability to pay full tuition, as reasons for their recruiting efforts.

IV. Country of Origin Analysis

A. Theoretical Framework

Our work is motivated by an economic model of demand for U.S. higher education among potential students from abroad. Following the most basic principle of economics, there should be a negative relationship between enrollment and relative cost of attending a U.S. institution versus the best alternative from the home country. Price of attendance includes monetary costs of tuition, room and board, and travel expenses. Assuming that U.S. education is a normal good – in fact, one could argue that it is a luxury good – income should positively affect enrollment, *ceteris paribus*. Foreign student demand also depends on outside options, i.e. the availability of comparable substitutes in their home country. Students with a larger number of high quality institutions in their set of options would be less likely to choose a U.S. institution.

To estimate a reduced form model of foreign student demand, we use data from the Institute of International Education (IIE) which gives the number of students enrolled at U.S. colleges and universities by country of origin and academic level (undergraduate versus graduate). The data go back several decades, but we focus on more complete data from recent years.²¹ To measure relative price, we use yearly exchange rate data from the Center of International Comparisons at the University of Pennsylvania. We use this measure, instead of relative tuition prices, for a number of reasons. First, exchange rate fluctuations represent a relatively exogenous change in relative price of attendance. Second, our analysis is at the country-of-origin level, so cost of attendance would have to be averaged

²¹ A full list of the countries in our analysis sample, as well as the corresponding number of years for which we have observations, is in Appendix Table A4.

across all undergraduate institutions in the U.S. and abroad. Third, we lack a consistent data source for trends in tuition outside the U.S. To measure income, we use gross domestic product (GDP) per capita data collected from the World Bank. To measure availability of home country options for higher education, we use country of origin's tertiary school aged population data from the United Nations. This variable measures the amount of competition students' face for seats at home country institutions. Particularly at elite institutions, the number of seats is fairly inelastic with respect to changes in tertiary school aged population. Thus, countries with increasing population of young people have experienced amplified competition to get into home country institutions. A recent *New York Times* article describes how even the most qualified students in India are being crowded out of top Indian colleges (Najar, 2011). China's admission process, which relies solely on scores from the infamous *gao kao* exam, is a highly competitive and stressful ordeal for students and parents which results in only 3 in 5 students being admitted to any Chinese college (LaFraniere, 2009).

B. Econometric Setup

Our basic specification for our country of origin analysis is:

$$\ln(\text{Enrollment}_{ct}) = \beta_1 \ln(\text{ExchangeRate}_{ct}) + \beta_2 \ln(\text{GDPpercapita}_{ct}) \\ + \beta_3 \ln(\text{TertiaryAgePopulation}_{ct}) + \mu_c + \nu_t + \epsilon_{ct}$$

where c designates country and t designates year. We include country fixed effects (μ_c) to account for time invariant idiosyncrasies across countries that affect student demand for U.S. higher education, such as distance from the U.S. or commonality of the English language. We include year fixed effects (ν_t) to capture world-level trends in foreign student enrollment in the U.S., such as the dip in foreign enrollment after 9/11. We present all variables to natural log to allow for interpretation of the coefficients as elasticities. We weight all country of origin regressions by base year total population.²²

ExchangeRate_{ct} is foreign currency to U.S. dollars, so an increase in ExchangeRate_{ct} means that a

²² Tables A2 and A3 in the Appendix show results for unweighted regressions.

U.S. education becomes relatively more expensive. For example, the Japanese exchange rate decreased from 93.57 yen/dollar to 87.78 yen/dollar between 2009 and 2010. Since fewer yen are needed to exchange for one U.S. dollar, the relative cost of a U.S. undergraduate education became relatively cheaper for prospective Japanese students.

Table 3 shows results from our basic regressions. In Columns (1) and (2), $Enrollment_{ct}$ is equal to total undergraduate enrollment from country c in year t , and equal to total graduate enrollment in Columns (3) and (4).²³ We compare two different year spans, 1998-2010 and 2003-2010, in order to get a sense for how the most recent influx of foreign enrollment differs from a longer trend.²⁴ The negative relationship between exchange rates and undergraduate enrollment indicates that foreign students are sensitive to changes in relative prices of education caused by fluctuations in exchange rates. For example, the coefficient in column (1) indicates that a 10% increase in the exchange rate of country c (a relative increase in cost to prospective students from country c) decreases foreign enrollment from country c by 2.88%. The negative relationship grows stronger when the sample is restricted to the later years. However, the coefficient on the exchange rate variable is close to zero for graduate enrollment (Columns 3 and 4), supporting our hypothesis that demand for foreign graduate education is less sensitive to changes in relative prices since most doctoral students are fully funded by institutions.

Table 3 also shows that undergraduate enrollment is strongly associated with GDP per capita and college-aged population in the country of origin. We expected that home country income should have a strong relationship with undergraduate enrollment (Columns 1 and 2), as U.S. institutions are among the highest priced in the world. Again, the coefficient on GDP per capita is significantly less for graduate enrollment (Columns 3 and 4), though still positive as GDP per capita is correlated with number of people with undergraduate degrees, the population that provides potential supply for graduate education. The

²³ Note that when we report our results, “years” indicate the fall year of enrollment. For example, 1998 corresponds to the 1998-99 academic year.

²⁴ We do not go back further than 1998 because the college-aged population variable is not available for years prior to 1998.

large, positive coefficient on college-aged population for undergraduate enrollment is particularly interesting, indicating that a 10% increase in college-aged population is associated with a 22-35% increase foreign undergraduate enrollment from the sending country. This result is consistent with Rosenzweig's constrained domestic schooling model, in which students come to study in the U.S. due to a lack of options in their home country. Due to high start-up and expansion costs, capacity in higher education is fairly inelastic with respect to fluctuations cohort size in the short run.²⁵ The coefficient on college-aged population for the graduate enrollment regressions is more modest, though the variables are still highly related.

To further test the hypothesis of constrained domestic schooling model, we add another variable to our analysis to measure students' home country options. Using *U.S. News World's Best Universities* rankings from 2012, we coded the number of universities from the top 400 list located in each country. The U.S. has the highest number of universities on this list (83), followed by the United Kingdom (45), Germany (35), Australia (22), France (19), Japan (16), and Canada (16). Nearly 60% of the top 400 world universities are located in these seven countries, with the remaining 40% spread throughout the world. To account for differences in population, we divide the number of top 400 universities in each country by its college-aged population in the base year of analysis (i.e. 1998 or 2003).²⁶ The resulting measure has a mean of 1.46 top universities per 100,000 college-aged people, with a standard deviation of 4.11. The countries with the largest values are Finland, New Zealand, and Switzerland; the countries with the smallest, non-zero values are India, Indonesia, and China.

The measure of "universities per capita" does not vary across time, and thus does not enter into our regression equation by itself. Instead, we interact universities per capita with college-aged population. The results are shown in Table 4. The coefficients on exchange rate, GDP per capita, and college-aged population remain very similar with the addition of the interaction. The negative coefficient

²⁵ This is also true in the U.S., as shown in Bound & Turner (2007).

²⁶ Presumably, the number of top 400 universities has not changed much in the past 10-15 years for most countries, so we do not attempt a time varying measure of universities per capita.

on the interaction of college-aged population and universities per capita implies that the positive relationship between college-aged population and undergraduate enrollment grows weaker as universities per capita increase. Again, this is consistent with the constrained domestic schooling model, as foreign students in larger cohorts are more likely to look to the U.S. for undergraduate education if they have fewer, well established home country options.

Fore reasons of political climate, cultural tastes, language education, and others, we expect the magnitudes of the determinants of demand to vary across different countries. When examining various region and country of origin level regressions, it becomes clear that China plays a large role in determining the results of our reduced form demand equation. In Table 5, we repeat our basic specifications from Table 3, excluding China from the regression. Most notably, the coefficient on the exchange rate variable appreciably decreases in absolute value in the undergraduate regressions, and loses significance. Excluding China from the regressions also decreases the coefficient values on GDP per capita and college-aged population, though the estimates remain statistically and economically significant.

Why does Chinese enrollment have such a strong relationship with the exchange rate? The recent history of the yuan/dollar exchange rate provides some insight to this question. Figure 5 depicts the trend in the exchange rate over our analysis period. Beginning in the mid-1990's, a dollar pegged exchange rate was an integral part of Chinese monetary policy. From 1998-2004, the yuan/dollar exchange rate remained effectively constant at 8.28. After continued pressure from the U.S. government, which argued that an artificially high exchange rate was distorting the trade-deficit, the Chinese modified their currency valuation policies in mid-2005 (Goodman, 2005).²⁷ As a result, the yuan appreciated by 22% between 2005 and 2010. Coupled with a growing middle-class, Chinese consumers have significantly increased their purchases of luxury goods, from clothing to cars, from American and European companies in recent years (CNBC, 2013; Rapoza, 2013). According to a 2013 article in *The Economist*, "from 2007 to 2011

²⁷ U.S. officials still argue that China is keeping its exchange rate artificially high (Economist, 2009).

many luxury-goods firms enjoyed double-digit growth in China, which became their most important market.” We argue that an undergraduate education at a U.S. institution, particularly at a high-quality U.S. institution, fits the bill of a luxury good. Therefore, it follows that we should expect, and indeed see, that determinants of foreign demand for Chinese students are so statistically significant and large in magnitude.

V. Conclusion

Basic microeconomic theory provides substantial insight in understanding the dramatic increase in undergraduate enrollment over the last 15 years. We theorize that income, availability of substitutes, and price are the main determinants of foreign demand (or quantity demanded) for U.S. higher education. By focusing on recent years in which foreign undergraduate enrollment has increase substantially, we show that changes in GDP per capita, exchange rates, and college-aged cohorts have increased demand for undergraduate education. In effect, increases in foreign GDP imply that students from abroad are now more likely to be able to afford U.S. higher education with higher income, while exchange rate fluctuations effectively alter price. We also use college-aged population to measure excess demand for the home country’s higher education system. The effects of this variation are magnified for students from countries where the supply of higher educational opportunities comparable to the U.S. is likely to be constrained, as measured by the number of top universities located in students’ home countries.

We find significant results for these variables: in our preferred specification, a 10% increase in GDP per capita leads to a 6.6% increase in foreign enrollment; a 10% increase in exchange leads to a 3.2% decrease in foreign enrollment. A 10% increase in college-aged population leads to a 23% increase in foreign enrollment for countries with no top world universities; however, this effect is mitigated for countries with a number of similar options.

Implications for the U.S. higher education market are multifold. First, while substantial and persistent rates of economic growth particularly in countries like China would imply continued increases in demand, a dramatic economic slowdown would also imply retrenchment in demand from abroad. Secondly, over the longer term, if countries that now send a substantial number of students to the U.S. make substantial additions to their higher education infrastructure, we would expect foreign demand to abate. Thirdly, as the supply of U.S. higher education is not perfectly elastic, particularly in the short term, a continued surge in demand among foreign students may have consequences on domestic students through crowd out.

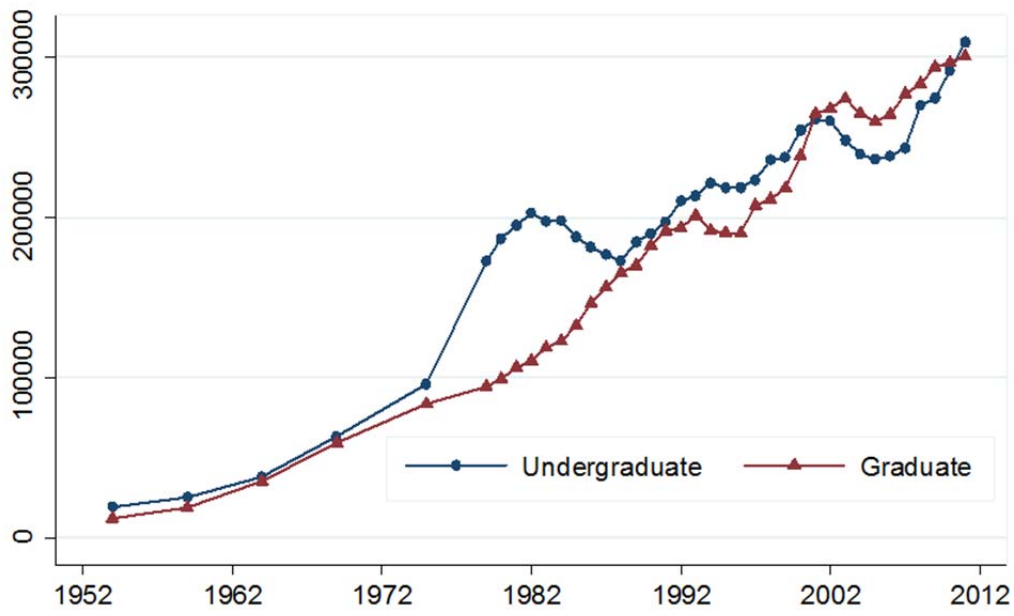
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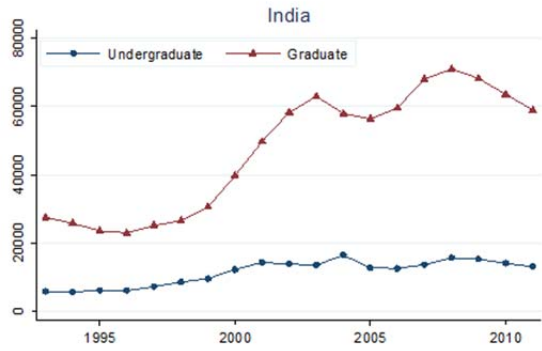
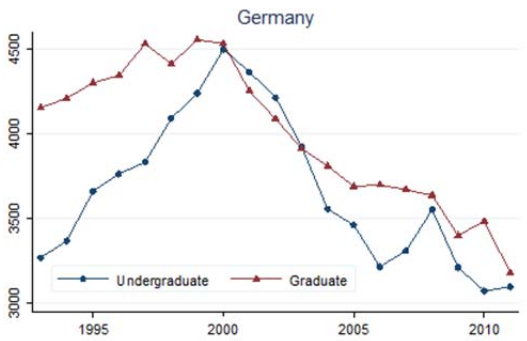
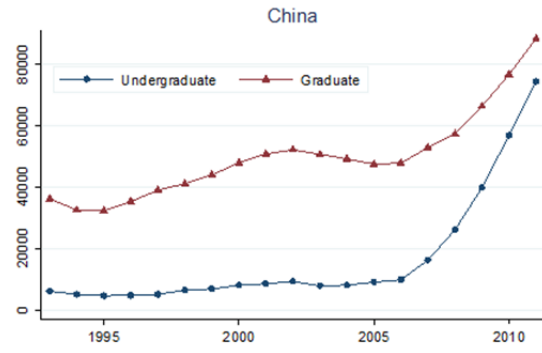
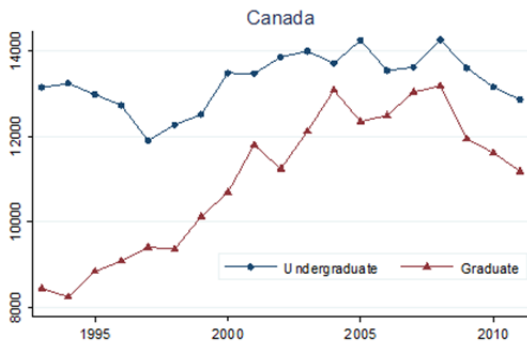
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Figure 1: Overall trend in foreign enrollment by education level, 1954-2011



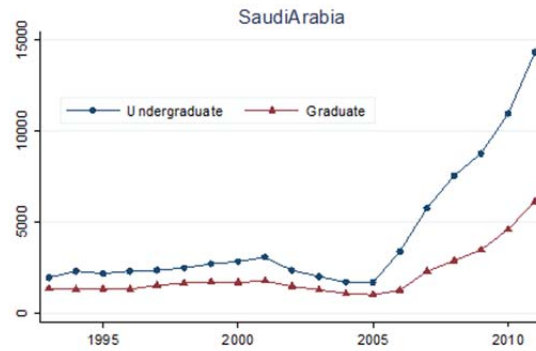
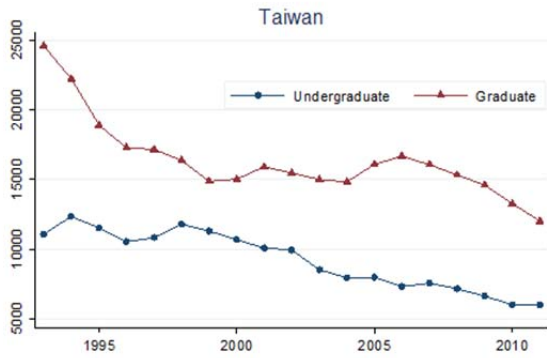
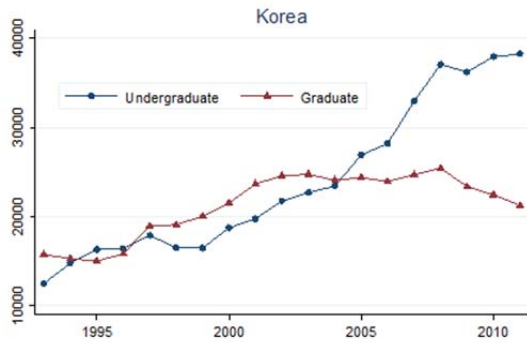
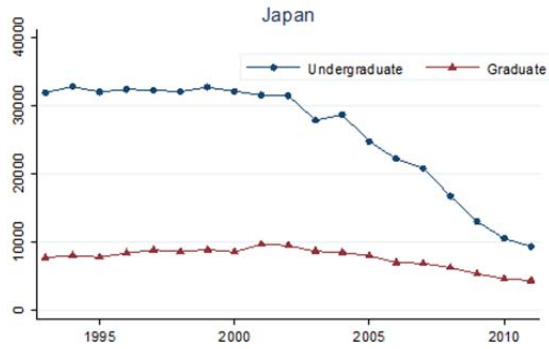
Source: Institute of International Education Open Doors Data

Figure 2: Foreign enrollment trends by major countries of origin, 1993-2011



Source: Institute of International Education Open Doors Data

Figure 3: Foreign enrollment trends by major countries of origin, 1993-2011



Source: Insitute of International Education Open Doors Data

Figure 4: Share of foreign students, by institution type

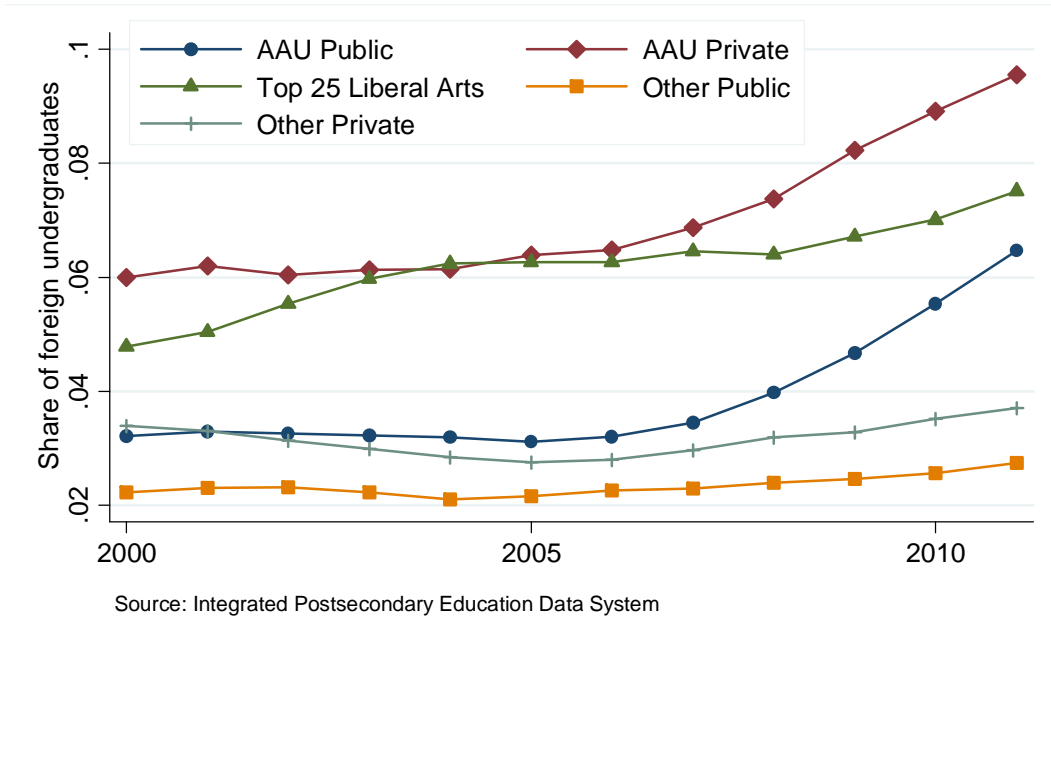


Figure 5: Chinese yearly Exchange rate, 1998-2010

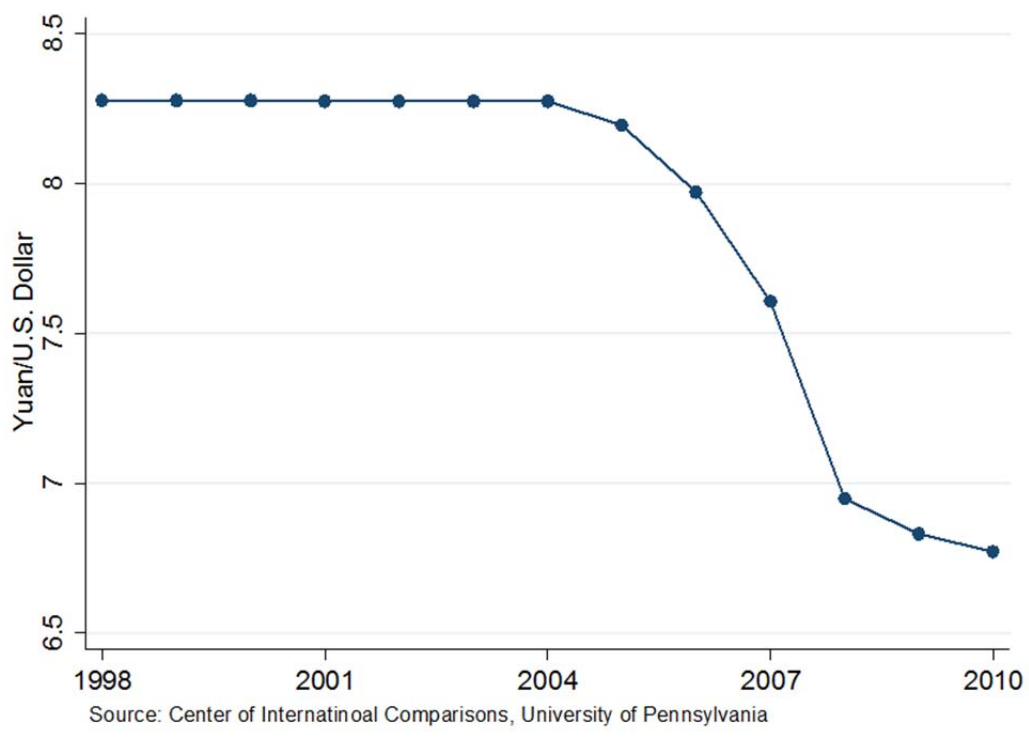


Table 1: Leading Countries of Origin for U.S. Enrollment, 1993 and 2011

Undergraduate Enrollment					
2011			1993		
1	China	74,516	1	Japan	31,960
2	South Korea	38,232	2	Canada	13,149
3	Saudi Arabia	14,344	3	South Korea	12,521
4	India	13,509	4	Malaysia	11,289
5	Canada	12,866	5	Taiwan	11,067
6	Vietnam	11,244	6	Hong Kong	10,427
7	Japan	9,359	7	Indonesia	7,982
Leading Country Total		174,070			98,395
Top 7 as % of total		56.27%			46.10%
TOTAL		309,342			213,610
Graduate Enrollment					
2011			1993		
1	China	88,429	1	China	36,370
2	India	59,014	2	India	27,533
3	South Korea	21,260	3	Taiwan	24,623
4	Taiwan	12,007	4	South Korea	15,785
5	Canada	11,190	5	Canada	8,455
6	Turkey	6,198	6	Japan	7,755
7	Saudi Arabia	6,133	7	Thailand	5,621
Leading Country Total		204,231			126,142
Top 7 as % of total		67.98%			62.70%
TOTAL		300,430			201,030
Source: IIE Open Doors					

Table 2: Institutions with highest number and share of foreign undergraduates

	1990		2011	
	Temp.	%	Temp.	%
	Res.	Temp	Res.	Temp
<i>Institutions with largest number of foreign undergraduates, 2011</i>				
Purdue University, Main Campus	585	1.9%	4,548	14.2%
University of Illinois at Urb-Champ.	338	1.2%	4,197	13.0%
Fort Hays State University	2	< 0.1%	3,891	34.9%
Michigan State University	444	1.3%	3,513	9.6%
University of Washington - Seattle	516	2.1%	3,140	8.0%
<i>Institutions with largest share of foreign undergraduates, 2011</i>				
Fort Hays State University	2	< 0.1%	3,891	34.9%
Brigham Young University, Hawaii Campus	341	16.1%	1020	34.6%
Mount Holyoke College	179	9.4%	554	23.6%
Illinois Insitute of Technology	144	5.9%	567	20.9%
Earlham College	22	1.9%	195	18.2%
<i>Private research universities with largest share of foreign undergraduates, 2011</i>				
Carnegie Mellon University	149	3.3%	746	12.5%
University of Miami	812	9.2%	1,295	12.3%
University of Southern California	1,145	7.3%	2,137	12.2%
California Institute of Technology	83	10.2%	118	12.1%
Boston University	1971	10.8%	2163	12.0%
<i>Public research universities with largest share of foreign undergraduates, 2011</i>				
Purdue University, Main Campus	585	1.9%	4,548	14.2%
University of Illinois at Urb-Champ.	338	1.2%	4,197	13.0%
Indiana University at Bloomington	658	2.4%	3,132	9.6%
Michigan State University	444	1.3%	3,513	9.6%
University of California-Berkeley	705	3.3%	2,423	9.4%
<i>Private liberal arts colleges with largest share of foreign undergraduates, 2011</i>				
Mount Holyoke College	179	9.4%	554	23.6%
Earlham College	22	1.9%	195	18.2%
College of the Atlantic	5	2.2%	60	16.9%
Bryn Mawr College	87	6.6%	209	15.9%
Westminster College	1	0.1%	176	15.8%

Table 3: Basic Country of Origin Regressions

	Undergraduate		Graduate	
	1998-2010 (1)	2003-2010 (2)	1998-2010 (3)	2003-2010 (4)
Ln(Exchange rate)	-0.302*** (0.087)	-1.192*** (0.272)	0.022 (0.046)	-0.131 (0.094)
Ln(GDP per capita)	0.688*** (0.165)	0.794*** (0.190)	0.127 (0.066)	0.183* (0.077)
Ln(College-aged Population)	2.191*** (0.355)	3.487*** (0.636)	1.236*** (0.149)	1.203*** (0.229)
R-Squared	0.963	0.976	0.992	0.996
N	2107	1305	2106	1305

Notes: Each column represents a separate regression. The unit of observation in all regressions is country of origin x year. The dependent variable in all regression is the natural log of undergraduate or graduate enrollment from a given country of origin in U.S. institutions. All regressions include year and country of origin fixed effects, and are weighted by the country of origin's population average over the year range. Data sources: IIE Open Doors; International Comparisons of Production, Income, and Prices at the University of Pennsylvania; The World Bank; UN data.

Table 4: Basic Country of Origin Regressions

	Undergraduate		Graduate	
	1998-2010 (1)	2003-2010 (2)	1998-2010 (3)	2003-2010 (4)
Ln(Exchange rate)	-0.322*** (0.090)	-1.222*** (0.276)	0.007 (0.048)	-0.144 (0.097)
Ln(GDP per capita)	0.661*** (0.162)	0.752*** (0.193)	0.106 (0.066)	0.163* (0.080)
Ln(College-aged Population)	2.334*** (0.374)	3.654*** (0.673)	1.348*** (0.162)	1.280*** (0.247)
Ln(CAP) * Universities Per Capita	-0.214*** (0.051)	-0.212* (0.095)	-0.167*** (0.029)	-0.097** (0.037)
R-Squared	0.963	0.977	0.992	0.996
N	2107	1305	2106	1305

Notes: Each column represents a separate regression. The unit of observation in all regressions is country of origin x year. The dependent variable in all regression is the natural log of undergraduate or graduate enrollment from a given country of origin in U.S. institutions. All regressions include year and country of origin fixed effects, and are weighted by the country of origin's population average over the year range. Data sources: IIE Open Doors; International Comparisons of Production, Income, and Prices at the University of Pennsylvania; The World Bank; UN data.

Table 5: Basic Country of Origin Regressions (No China)

	Undergraduate		Graduate	
	1998-2010 (1)	2003-2010 (2)	1998-2010 (3)	2003-2010 (4)
Ln(Exchange rate)	-0.043 (0.026)	-0.149* (0.068)	0.009 (0.025)	-0.028 (0.060)
Ln(GDP per capita)	0.205*** (0.032)	0.216*** (0.046)	0.134*** (0.030)	0.106** (0.041)
Ln(College-aged Population)	0.940*** (0.097)	0.885*** (0.155)	1.348*** (0.091)	1.211*** (0.137)
R-Squared	0.975	0.987	0.988	0.995
N	2094	1297	2093	1297

Notes: Each column represents a separate regression. The unit of observation in all regressions is country of origin x year. The dependent variable in all regression is the natural log of undergraduate or graduate enrollment from a given country of origin in U.S. institutions. All regressions include year and country of origin fixed effects, and are weighted by the country of origin's population average over the year range. Data sources: IIE Open Doors; International Comparisons of Production, Income, and Prices at the University of Pennsylvania; The World Bank; UN data.