

Exchange Rate Volatility and International Students' Educational Choice in the United States

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Abstract

Does the economic situation prevailing in the home country of an international student affect his/her educational choice in the U.S.? To address this question, I use exchange rates as exogenous price shocks to the international students' budget constraint to pay for higher education in the host country. To theorize, in response to changes in real exchange rates, how the foreign students' demand behaviour in terms of educational attainment is affected is studied in this paper. For estimation, data from several sources for 2000-2019 time-period is used. Although insignificant, I find international undergraduate enrollment decreases as prices of education increases caused by fluctuations in the exchange rate. However, this isn't true for graduate enrollment. The paper also exploits other macroeconomic indicators and availability of substitutes in the home country that affects foreign demand for U.S. higher education. The theoretical model further elucidates the empirical puzzle of the foreign students' demand behavior in terms of educational attainment.

Keywords: Education, Human Capital, Migration

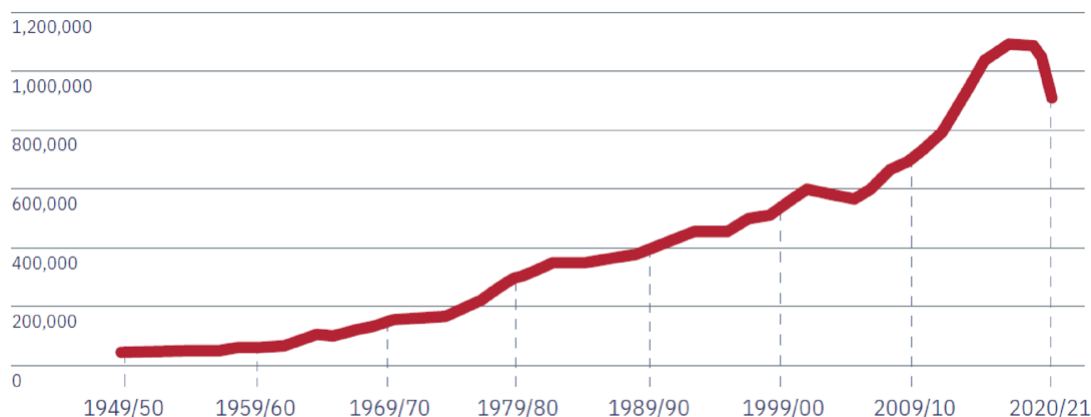
JEL Codes: I23, J240, I250

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1 Introduction

United States is considered as a well-known destination for educational choice for students from abroad owing to its high-quality education system, welcoming culture, and relatively open labor market. Recent decades have witnessed significant influx of international students travelling outside their home country for education and experience abroad (Figure 1).¹ U.S. universities dominates the world university rankings, with 157 institutions ranked in the 2019 edition in total. 8 of the top 10 universities are located in the U.S. based on the rankings of the research universities.² The number of international students in the United States set an all-time high in the 2018-19 academic year, the fourth consecutive year with more than one million international students.³ According to the data released by the U.S. Department of Commerce's Bureau of Economic Analysis, U.S. hosted over one million students in 2019/2020 academic year and reported \$38.96 billion in education exports, which supported over 415,990 U.S. jobs.

Figure 1: International Students in the U.S., 1948-2020



Source: Open Doors, International Educational Exchange (IEE).

Note: Years are the fall year of enrollment

When deciding on the destination for higher education students are influenced by several factors. These factors include cost of education (tuition fees), cost of living and other goods and services purchased in local economies, travel expense, the reputation and ranking of universities, the success of the marketing of universities abroad, labor market outcomes (option value to employment) and the ease of entering and exiting the destination countries (student visa regulations). Factors such as the cost of university tuition fees and living expenses are largely influenced by fluctuations in exchange rates, particularly between the

¹In 2020/21, the total number of international students declined by 15% from the prior academic year. This decrease was primarily due to the effects of the COVID-19 pandemic.

²Source: U.S. New World's Best Universities rankings, 2019.

³Source: 2019 Open Doors Report on International Educational Exchange (IEE).

country of origin of the student and the country of destination [Abbott and Ali, 2009].

Prior literature has focused on enrollment trends of doctoral students [Bound et al., 2009]; how tuition fees, U.S. federal support of education, and the size of the ‘young’ generation of source countries affects international student mobility [Liu and Wang, 2009]. [Rosenzweig et al., 2006] proposed 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 hypothesizes that foreign students enroll in the U.S. to increase the probability that they will find employment in the U.S. when they graduate. [Bound et al., 2020] finds a link between changes in state funding and foreign enrollment. [Kato and Sparber, 2013, Shih, 2016] test how decreasing H-1B visa quotas for most countries affected foreign enrollment.

The work in this paper is motivated by an economic model of demand for U.S. higher education focusing on undergraduate and graduate students’ from abroad. In this paper I use exchange rates as a deterministic factor for the foreign students to enroll in an educational institute in the U.S. With a real appreciation of the U.S dollar, the expenses to be incurred by the international student in terms of their home country’s currency on the choice of education to be obtained from an U.S. educational institute rises. And hence we should expect a negative relationship between enrollment and the relative cost of attending a U.S institution. However, given the heterogeneity among countries in terms of economic and non-economic factors- this relationship might not always hold true. The price of attendance includes tuition and campus fees, room and household utilities, travel expenses etc. Therefore, the exchange rate fluctuations represent a relatively exogenous change in relative price of attendance. I also control for other economic factors at home that can affect the supply of students’ in the host country. I present a conceptual model to understand the migration decisions of a student when exchange rate fluctuates and test it empirically. The objective is to understand how exchange rate and other demand factors from different countries abroad, determine the inflow of students’ in the U.S.

The remainder of this paper is organized as follows: Section 2 deals with the existing literature on human capital investment by the foreign students and other labour market outcomes with response to exchange rate shocks. Section 3 discusses the theoretical and conceptual framework. Section 4 discusses in detail about the different sources of data used in this paper. Section 5 provides the enrollment trends by major country of origins and U.S. institutions. Section 6 and 7 discusses about the econometric framework, the empirical findings and the results and interpretations. The last section concludes.

2 Literature Review

Why international student enrollment is important? A wider recruiting pool not only means more qualified students [Peterson et al., 1999], but also brings diversity and cultural communication in to campus and encourages conversation among groups of different demographics as well as presents inspiring innovative ideas. Economically, higher education institutions and their community both significantly benefit from international students as their enrollment is a major industry of export service in the U.S. [Hegarty, 2014]. As international student body increases, the tuition become a large income source for higher education, which could be used into institution expansion and system innovation. International student enrollment is also closely related to the labor market in the host country, because students have a high possibility to stay in the host country for internships, jobs and volunteer positions [Shih, 2016] due to higher wage premiums compared to the source country. Although voluminous literature has focused on identifying several determinants of international migration [Bird and Turner, Abbott and Silles, 2016, Beine et al., 2014], but addressing the topic of international student enrollment with respect to exchange rate fluctuations is limited.

Interaction between the changes in exchange rate and the direction of international trade is something that has gained attention among several researchers [Auboin and Ruta, 2013, Kang and Dagli, 2018]. Existing literature has also documented a set of correlations between various macroeconomic variables and remittance flows [Yang, 2008, Nekoei, 2013]. In contrast, the exchange rate effect for academic decision- to enroll for higher education in a U.S institution will be interesting to study. Research documents immigrants' enrollment behavior correlating with supply side micro-economic factors [Shih, 2016, Kato and Sparber, 2013]. International students particularly in the science, technology, engineering and mathematics (STEM) fields increases the high skilled workers in the U.S. economy [Rosenzweig et al., 2006]. [Borjas, 2004] discusses about immigrants' enrollment in comparison to natives in the U.S. and subsequently the effects on the labor market. The increased flow of international students to U.S. schools, colleges and universities raises questions of crowd- out, as these students may reduce academic opportunities for natives while also pacing downward pressure on wages in the labor market. While this issue of crowding-out effect is not discussed in this paper, but a strong motivation from literature that helped to form the understanding the basics of the flow of the immigrant students. My research deals with understanding the demand side behavior of the international migrants from different countries abroad with respect to fluctuations in exchange rate.

[Bound et al., 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. Mainly literature focuses on graduate-level students or aggregate undergraduate and graduate students into one measure of foreign enrollment. However, in this paper I try to show the enrollment decisions with exchange rate fluctuations of overseas students by undergraduate and graduate level.

[Bound et al., 2020] tells a compelling story about the link between changes in state funding and foreign students' enrollment for the period between 1996 and 2012. They present evidence showing that a significant set of public universities were able to take advantage of the expanding pool of potential students from abroad to provide a stream of tuition revenue that partially offsets declining state appropriations.

A few papers explore motivations for foreign students coming to study in the United States. [Rosenzweig et al., 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 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.

[Kato and Sparber, 2013] employ the same enrollment data I use in my 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 students 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.

This paper differs from the literature in discussing about the influx of student's decision to study in the

U.S. educational institution. I examine how economic factors at home affect the supply of students' in the host country, where I take advantage of variation in a macroeconomic variable- exchange rate to examine its impact on the college enrollment decisions (undergraduate and graduate) of the migrant. The objective is to understand fluctuation in the exchange rate from different countries abroad, determine the flow of students' in the U.S.

3 Theoretical Model

This section presents a theoretical framework to capture the channels through which an international student's home country economy may affect her educational choice in the host country. The main channel for this effect is the purchasing power of education (relative cost of attending a U.S institution) which depends on the real exchange rate between their host and home countries. In theory, how should transitory income shocks due to exchange rate movements affect household investments in child human capital and in household enterprises? If households are wealthy and have complete access to credit, transitory shocks should have no effect on such investments (child's education). However, if shocks are large enough to affect permanent or lifetime income materially, income effects might lead households to change their investment behavior for their children even when there are perfect credit markets. For example, child human capital may be a normal good for households, [Becker, 1965]. Assuming U.S education as a normal good (or, arguing it to a luxury good), increase in household income should affect child human capital investment (increasing enrollment in U.S. institution), *ceteris paribus*.

When household investments require fixed costs be paid in advance of the investment returns (i.e. the child earning after the completion of education) and when households face credit constraints, the timing of household investments may depend on current income realizations. Households may raise investments when experiencing positive income shocks. When exchange rate increases, i.e., if there is a real appreciation of the US dollar, then the burden of educational expenditure is higher for the family as U.S. education becomes expensive. The effects of a change in the real exchange rate on earnings can be separated into substitution and income effects. A substitution effect of an increase in real exchange rate results in decline in the enrollment in the host country as it is difficult to pay for education costs. Individuals would like to stay back in the home country. Again, the income effect of this currency appreciation entails a decrease in income to support for education and enrollment in the U.S. institution is expected to fall. However, the effects discussed is expected if the exchange rate shocks are large enough to affect income of the household materially. The total effect of this appreciation thus depends on the relative magnitude of the exchange rate shocks on income and substitution effects. To understand this economically, I use a simple model using credit

constraints of an individual and discuss about their migration decisions to study abroad when exchange rate fluctuates.

Consider the two-period utility function as:

$$U(C_t, C_{t+1}) = \ln C_t + \beta \ln C_{t+1} \quad (1)$$

where C is the consumption of an individual and t is the time-period.

Case-1: *When the student is not going to the foreign country for higher education and getting educated in the home country. The budget constraint is:*

$$\text{Period-1: } C_t + s_h = I_0 - p_h e$$

$$\text{Period-2: } C_{t+1} = s_h(1 + r) + w_h$$

where e is the education good, p is the price of education, s_h is the individual's savings ($s_h > 0$)/borrowings ($s_h < 0$). Any borrowings/savings yields a return of $s_h(1 + r)$ in the following period. I_0 is the non-wage income and w_h is the wage at home. h in the subscript denote home country.

Case-2: *When the student is going to a foreign country for higher education but not staying in the host country after completion of the degree. The budget constraint is:*

$$\text{Period-1: } C_t + s_h = I_0 - \gamma(p_f + \tau)e_f$$

$$\text{Period-2: } C_{t+1} = s_h(1 + r) + w_h(e_f)$$

where $w_h(e_f)$ is the wage at home with U.S. degree, τ is the additional costs for higher studies abroad and γ is the exchange rate i.e. $(\frac{P_h}{P_f})$. f in the subscript denote foreign country.

Case-3: *When the student is going to a foreign country for higher education and staying in the host country after completion of the degree for employment opportunities. The budget constraint is:*

$$\text{Period-1: } C_t + s_f \gamma = I_0 - \gamma(p_f + \delta)e_f$$

$$\text{Period-2: } C_{t+1} = s_f(1 + r)\gamma + w_f$$

where $s_f \gamma$ is the individual's savings/ borrowings, w_f is the wage abroad, δ is the cost of migration ($\delta > \tau$).

Let U_h , U'_h and U_f be the utility functions corresponding to Case-1, Case-2 and Case-3 respectively.

Proposition-1: *If an individual is on the margin between Case-1 and Case-2, then a higher exchange rate would make the individual more likely to choose the first option. Negative relationship is expected between*

enrollment and the relative cost of attending a U.S institution, with a real appreciation of the U.S. dollar.

$$\begin{aligned}
U'_h &\geq U_h \\
\implies \ln[I_0 - \gamma(p_f + \tau)e_f - s_h] + \beta \ln[w_h(e_f) + s_h(1+r)] &\geq \ln[I_0 - p_h e - s_h] + \beta \ln[w_h + s_h(1+r)] \\
\implies \ln\left[\frac{I_0 - \gamma(p_f + \tau)e_f - s_h}{I_0 - p_h e - s_h}\right] + \beta \ln\left[\frac{w_h(e_f) + s_h(1+r)}{w_h + s_h(1+r)}\right] &\geq 0
\end{aligned}$$

If γ increases, then it is evident that enrollment falls.

Proposition-2: *If an individual is on the margin between Case-1 and Case-3, then a higher exchange rate results in enrollment to drop or rise*

$$\begin{aligned}
U_f &\geq U_h \\
\implies \ln[I_0 - \gamma(p_f + \delta)e_f - s_f] + \beta \ln[w_f + s_f(1+r)\gamma] &\geq \ln[I_0 - p_h e - s_h] + \beta \ln[w_h + s_h(1+r)] \\
\implies \ln\left[\frac{I_0 - \gamma(p_f + \delta)e_f - s_f}{I_0 - p_h e - s_h}\right] + \beta \ln\left[\frac{w_f + s_f(1+r)\gamma}{w_h + s_h(1+r)}\right] &\geq 0
\end{aligned}$$

If γ increases, then the effect on enrollment is ambiguous.

Proposition-3: *If an individual is on the margin between Case-2 and Case-3, then effect on enrollment can be ambiguous due to the change in the exchange rate.*

$$\begin{aligned}
U_f &\geq U'_h \\
\implies \ln[I_0 - \gamma(p_f + \delta)e_f - s_f] + \beta \ln[w_f + s_f(1+r)\gamma] &\geq \ln[I_0 - \gamma(p_f + \tau)e_f - s_h] + \beta \ln[w_h(e_f) + s_h(1+r)] \\
\implies \ln\left[\frac{I_0 - \gamma(p_f + \delta)e_f - s_f}{I_0 - \gamma(p_f + \tau)e_f - s_h}\right] + \beta \ln\left[\frac{w_f + s_f(1+r)\gamma}{w_h(e_f) + s_h(1+r)}\right] &\geq 0
\end{aligned}$$

If γ increases, then the effect on enrollment is ambiguous.

4 Data

The paper uses various sources of data to estimate the reduced form model of foreign student demand for education in the U.S market based on the home country's economic situation. Enrollment data of international students by country of origin and academic level (graduate versus undergraduate) in the U.S. colleges and universities is taken from Institute of International Education (IIE), Open Doors. Open Doors is a comprehensive information resource on international students and scholars studying or teaching at higher education institutions in the United States, and U.S. students studying abroad for academic credit at their home colleges or universities. This survey of international exchange activity in the United States is

sponsored by the U.S. Department of State with funding provided by the U.S. Government and supported in its implementation by IIE.

Average yearly exchange rate at the country level is collected from the International Monetary Fund's (IMF) Financial Statistics database ⁴. The study uses the currency of the host country as the base currency and the currency of the source country as the quote currency.⁵

The economic indicators- gross domestic product (GDP) per capita, inflation rate, unemployment rate- are collected from the World Bank database. Per capita GDP of the source country is used to measure the financial status of the average students and their financial supporters in the source country. This is directly related to their affordability of tuition fees, living expenses and travel cost. Also, GDP per capita, measures the standard of living as well as the performance of a country, and is closely related to the direction and volume of the international student flow from the source country to the host country. Inflation rate and unemployment rate are used as an indicator of the health of a economy in the source country. The rate of inflation in a country can have a major impact on the value of the country's currency and the rates of foreign exchange it has with the currencies of other nations. These two macroeconomic variables from the source country are controlled for in my model in order to isolate the variation due to changes in terms of trade.

For some of these macro indicators- for example, inflation rate or unemployment rate- there existed some missing values in few years for some countries. Instead of dropping those countries, I used the dummy variable approach.⁶ While this technique has been used for many years, [Jones, 1996] and [Allison, 2003] and others have been critical of it. Allison calls this technique "remarkably simple and intuitively appealing". But unfortunately, "the method generally produces biased estimates of the coefficients". While the dummy variable adjustment method is unacceptable it may still be appropriate in cases where the value is truly missing as it does help the loss of power.

Availability of home country options for higher education is measured using the source country's tertiary aged population data from the United Nations. This variable measures the amount of competition students' face for seats in the home country. For example, the selectivity of top universities in India and China measured by applicants relative to admissions opportunities is greater than for the most elite private universities in the U.S.⁷ Thus, countries with increasing tertiary age population amplifies competition to get into home

⁴International Monetary Fund. Various years. "International Financial Statistics." <https://www.imf.org/en/Data>

⁵Relative tuition prices are not used as I do not find a consistent data source at the country level for trends in tuition fees in the U.S.

⁶For example, if there were 100 observations in a data set, and X is missing for 15 of the 100 observations, then: (1) set Z to zero and D to one for the 15 missing observations; (2) let Z equal X and set D to zero for the other 85 non-missing observations; and, (3) include both Z and D in the model in place of X. With this new specification the impact model will estimate the relationship between Y and X when X is not missing, and it will estimate the relationship between Y and D when X is missing.

⁷A 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 and Yuanxi, 2009]

country institutions [Bird and Turner].

My analysis involves the time-period 2000-2019.⁸ Unfortunately, due to the lack of data to capture other sociological, technological, environmental, political health related issues, economic factors are the only source of independent variables that have been introduced into the model of this study. Hence the study overstates the influence of economic factors on the international trade in education service.

5 International Students' Enrollment Trends in U.S.

International students' enrollment in the U.S. institutions has always witnessed a rising trend. Figure 2 shows the total enrollment of foreign students in the U.S. institutions by their academic level for the period 2000-2019. It is seen that foreign enrollment has an increasing trend overtime at both undergraduate and graduate level. Post 2001, the undergraduate enrollment drops till it again rises from 2010. 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 [Bird and Turner]. [Lowell and Khadka, 2011] document the post 9/11 decline and finds a 20% decrease in F1 visas issued between 2001 and 2002, a more modest decline in 2003, and then a period of rebound beginning in 2004. In their paper they 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. However, the period since the collapse of the financial markets in 2008, foreign enrollment has continued on a upward trajectory, rising 14.6% in the 2008-2011 interval among undergraduates and 6% among graduate students (Source: Open Doors, IIE). [Rosenzweig et al., 2006] argues that the number of foreign students who can enroll in US higher education is not limited by visa policy (but rather by conditions in the higher education market) foreign students have incentives to pursue degrees in the United States, both to acquire skills and to improve the potential likelihood of finding a job in the US labor market.

The period after 2011 witnesses an increase in undergraduate enrollment compared to graduate enrollment. 2015 onwards there is consistent deceleration in enrollments. According to the Open Doors report, officials with IIE and the State Department addressed the perception that President Trump's policies and rhetoric may have contributed to the decreases. They suggested a more relevant factor is the relatively high cost of U.S. higher education. However, the quality and intentions of institutions to attract international students remain positive, so the common factor one can isolate very easily is what changed in policies for immigration and visas. They even mentioned, "There were already some challenges from the competitive

⁸I do not have enrollment data for years prior to 2000 in IIE, Open Doors

Figure 2: Overall trend in foreign enrollment by academic level, 2000-2019

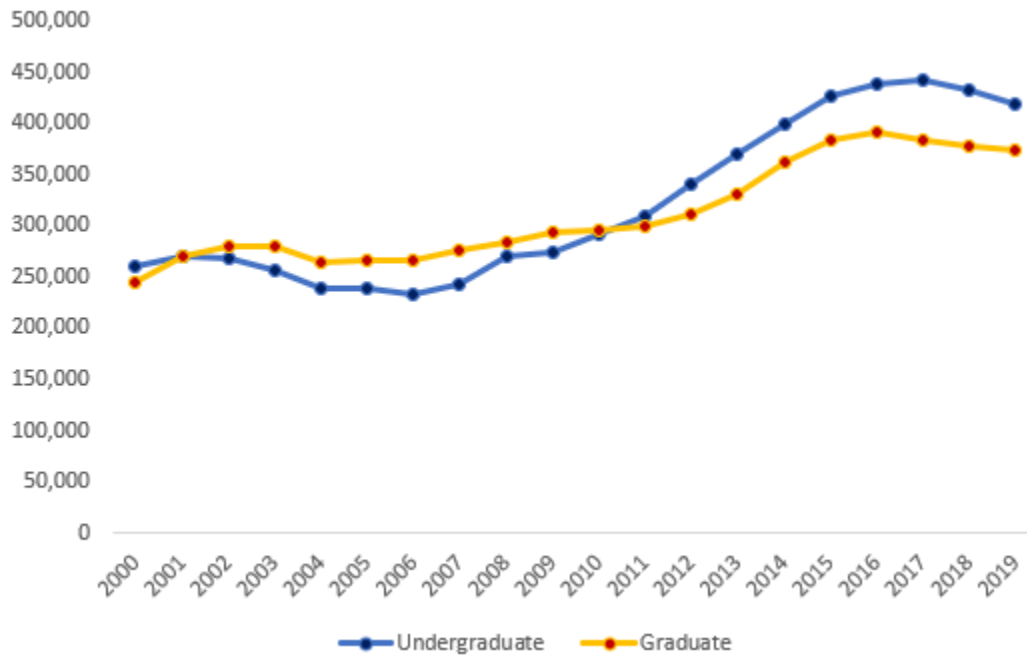
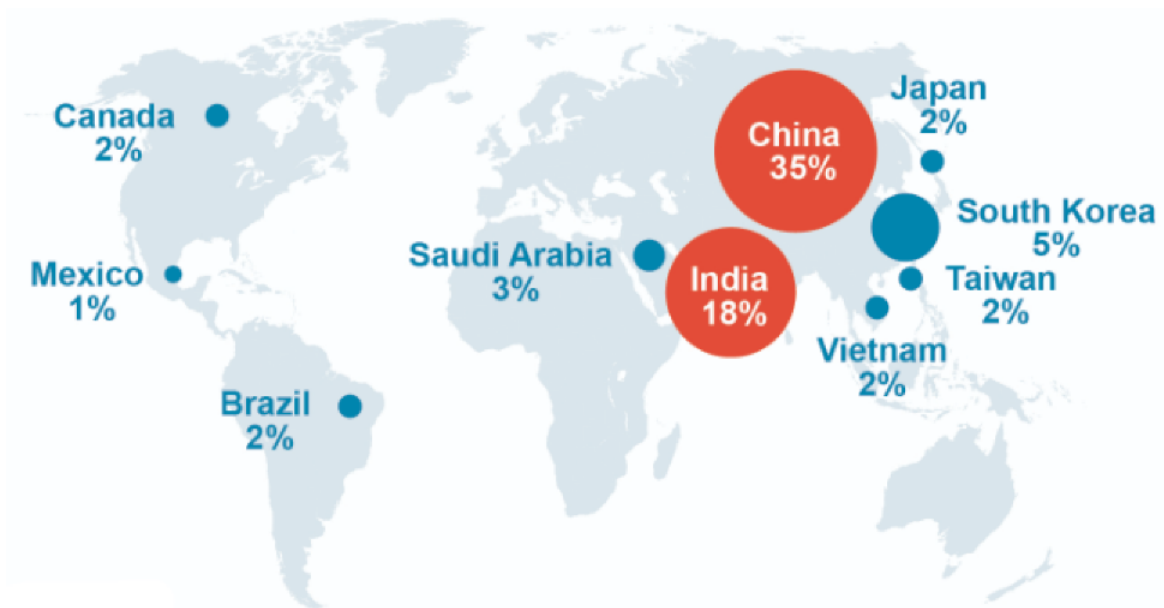


Figure 3: Top 10 Places of Origin of International Students



Source: Open Doors, International Educational Exchange (IEE).

environment, then the radical shift in the outlook for the U.S. as a study destination just made things worse for the students and institutions.”

Figure 3 shows the top 10 places of origin of international students overall (undergraduate, graduate, non- degree, OPT), with China and India leading the way. Table 1 presents the leading regions in 2000 and 2019 by the academic level of the foreign students. There has been marked increase in both undergraduate and graduate enrollment in Asia, Middle East and North Africa from 2000 to 2019.

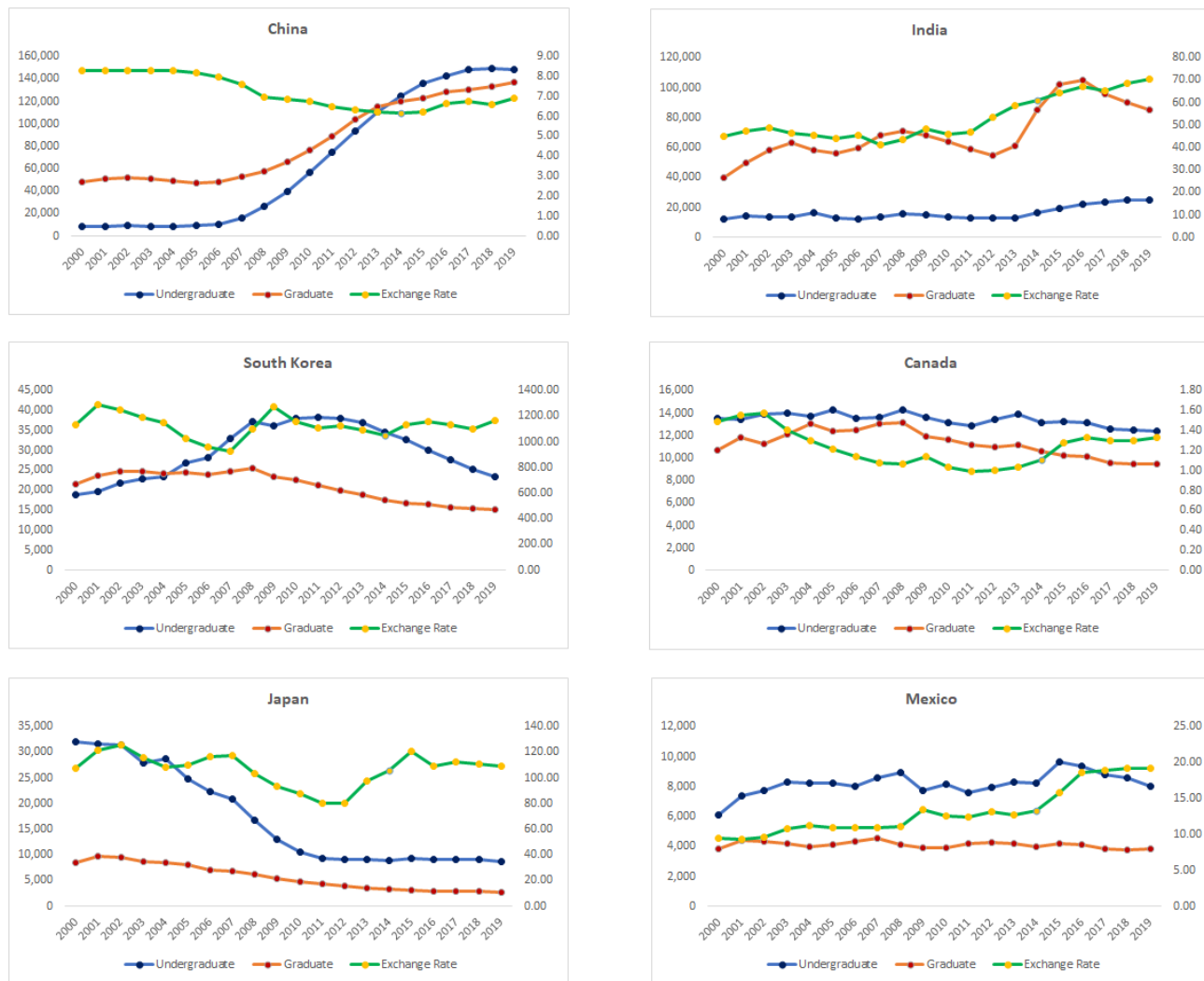
Table 1: Leading Regions for U.S. Enrollment by Academic Level, 2000 and 2019

Region	Undergraduate	Graduate	Undergraduate	Graduate
	2000		2019	
<i>Africa, Sub Saharan</i>	20,493	7,581	20,732	13,548
Central Africa	1,063	375	2,023	539
East Africa	7,550	2,702	5,878	2,717
Southern Africa	4,808	1,795	3,771	1,552
West Africa	7,066	2,707	9,060	8,740
Unspecified	6	2		
<i>Asia</i>	121,919	155,794	265,955	278,329
East Asia	76,076	95,054	192,748	166,101
South and Central Asia	22,930	45,501	39,167	101,000
Southeast Asia	22,913	15,239	34,040	11,228
<i>Europe</i>	46,409	39,360	37,730	25,626
<i>Latin America and Caribbean</i>	39,652	19,596	43,519	21,017
<i>Middle East and North Africa</i>	16,053	9,873	34,796	24,876
Middle East	13,867	7,621	32,055	22,145
North Africa	2,186	2,252	2,741	2,731
<i>North America</i>	13,480	10,694	12,409	9,488

Figure 4 shows the foreign enrollment trend in some of the major countries of origin from 2000 to 2019 along with the fluctuations in the exchange rate. Across countries, the trends in enrollment in U.S. higher education differ markedly, along with notable differences in the concentration of undergraduate and graduate students. Economics and politics play a role in choosing to study in the U.S. institution. For some countries- China, India- it is seen that the graduate enrollment is larger than undergraduate enrollment. Countries like Canada, Japan- undergraduate and graduate enrollment are near the same scale and exhibits modest variation over time. In Mexico and South Korea, undergraduate enrollment is higher compared to graduate enrollment.

Foreign enrollment by country of origin at the institution level and by institution type (public, private, liberal arts college, community college) is not available. Table 3 shows the top 20 U.S. institutions hosting the international students in 2018. Based on the top 20 institutions, it is seen most of the universities are public universities. The cost of education in public universities is lesser compared to private universities and public universities are more cost efficient when environmental factors influence cost frontiers [Sav, 2012].

Figure 4: Foreign Enrollment Trend & Exchange Rate Fluctuations by Major Country of Origin, 2000-2019



Lesser cost of education with higher quality of education paves the way for international students to attend U.S. public universities compared to private counterparts. However, the distribution of foreign students in the top 20 universities does not mirror their choice of U.S. institutions overall.

Table 2: Top U.S. Institutions Hosting International Students, 2018

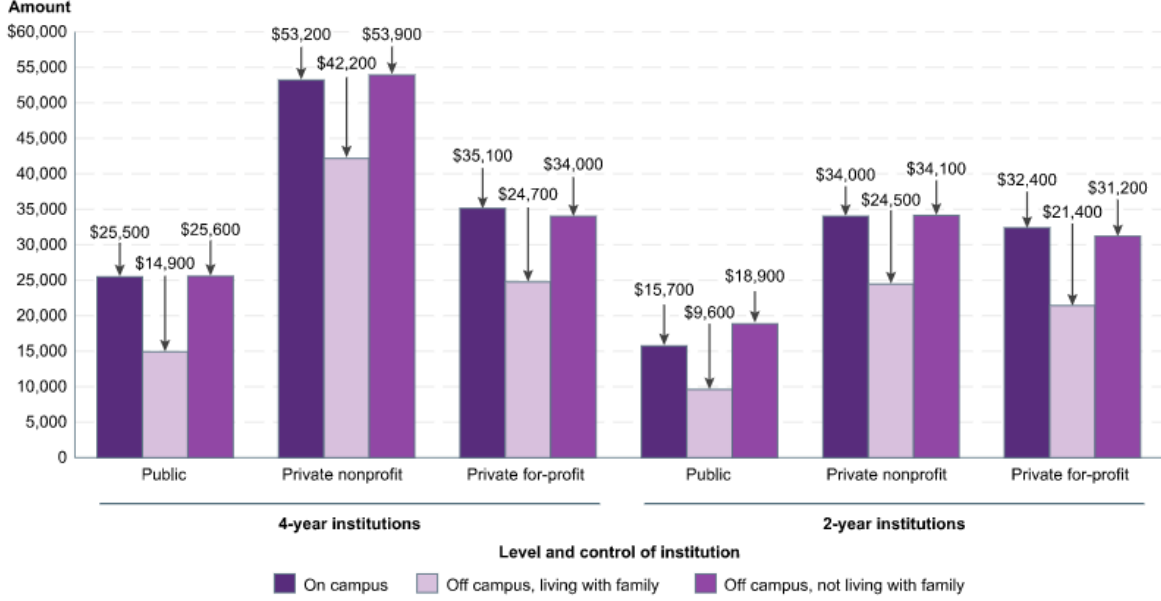
1	New York University	Private	19,605
2	University of Southern California	Private	18,340
3	Northeastern University- Boston	Private	16,075
4	Columbia University	Private	15,897
5	University of Illinois- Urbana Champaign	Public	13,497
6	Arizona State University, Tempe	Public	13,324
7	University of California, Los Angeles	Public	11,942
8	Purdue University, West Lafayette	Public	10,943
9	University of California, San Diego	Public	10,652
10	Boston University	Private	10,598
11	University of California, Berkeley	Public	10,063
12	University of Texas- Dallas	Public	9,401
13	Pennsylvania State University- University Park	Public	9,396
14	University of Washington	Public	9,311
15	University of Michigan- Ann Arbor	Public	8,726
16	Carnegie Mellon University	Private	8,669
17	University of California- Irvine	Public	8,064
18	University of California- Davis	Public	8,048
19	Ohio State University- Columbus	Public	8,020
20	Cornell University	Private	7,214

Figure 5 shows the average cost of education for undergraduate full- time students in U.S. institutions by institution type- public, private non- profit and private for- profit.⁹ Typically, private institutions has a larger cost of education compared to public universities. Among first-time, full-time undergraduate students in academic year 2019–20, the average total cost of attendance at 4-year institutions was similar for those living on campus and those living off campus but not with family. In comparison, the average total cost of attendance was lower for those living off campus with family. This pattern in the total cost of attendance was observed for public, private nonprofit, and private for-profit institutions. For example, at public 4-year institutions, the average total cost of attendance was 25,500 for students living on campus and 25,600 for students living off campus but not with family, compared with 14,900 for students living off campus with family.

However, of particular note, public institutions charges have risen at a greater rate in recent years. For example, a New York Times article [Lewin, 2011] notes that “more than half of the admissions officers at public research universities ... said that they had been working harder in the past year to recruit students who need no financial aid and can pay full price.” One story in the Chronicle of Higher Education [Hoover and

⁹Source: U.S. Department of Education, National Center for Education Statistics

Figure 5: Average total cost of attending degree-granting institutions for first-time, full-time undergraduate students, by level and control of institution and student living arrangement: Academic year 2019–20



Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS).

Keller, 2011] describes an “out-of-state goldrush” with admissions officers at public universities increasingly “hustling for business” to find new markets. The supply of foreign students from abroad is relatively more elastic and has become increasingly so as incomes in emerging economies have risen. This allows universities to use foreign enrollment as an important tool in recovering lost state appropriations. So, be it public or private, foreign enrollment is based on higher quality, higher expected returns from U.S. education or larger resources, which draws them to study in the U.S. institutions. So, income is an essential and significant factor that determines their choice of higher education.

6 Econometric Framework

My basic specification model is specified as follows:

$$\begin{aligned}
 \ln(\text{ForeignEnrollment})_{c,t} = & \beta_0 + \beta_1 \ln(\text{ExchangeRate}_{c,t}) + \beta_2 \ln(\text{GDPpercapita}_{c,t}) + \beta_3 \ln(\text{InflationRate}_{c,t}) \\
 & + \beta_4 \ln(\text{UnemploymentRate}_{c,t}) + \beta_5 \ln(\text{TertiaryAgePopulation}_{c,t}) + \delta_t + \delta_c + \epsilon_{c,t}
 \end{aligned}
 \tag{2}$$

where c and t stand for country of origin of foreign student and time-period.¹⁰ For interpretation of the coefficients as elasticities, natural logarithm is taken. δ_t and δ_c are the year and country fixed effects.

¹⁰Corresponds to the fall year of the academic year

Countries with fixed exchange rate are dropped for my analysis.

7 Results

Table 3 shows results as specified by equation 2. Column 1 and 3 shows a negative relationship between exchange rates and undergraduate enrollment indicating international students are sensitive to changes in prices of education caused by fluctuations in exchange rates. But, the estimate is insignificant. However, the negative relationship is not consistent when considering graduate enrollment. The coefficient in column 6 indicates that a percent increase in the exchange rate of source country increases graduate foreign enrollment in US institutions by 0.0695%. This can be explained by the fact that graduate students are normally funded through assistantships/fellowships by institutions [Bound et al., 2009].

Table 3: Baseline Regression

	Undergraduate			Graduate		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Exchange Rate)	-0.0047 (0.0377)	0.0279** (0.0086)	-0.0103 (0.0377)	0.0563 (0.0300)	0.0558*** (0.0103)	0.0695* (0.0317)
ln(GDP per capita)		-0.0421* (0.0204)	-0.2205* (0.1025)		-0.0311 (0.0227)	0.1808 (0.0978)
ln(Inflation Rate)		-0.0638 (0.0740)	-0.1114 (0.0853)		0.0937 (0.1015)	-0.1158 (0.0947)
ln(Unemployment Rate)		0.1488* (0.0623)	0.0588 (0.0706)		0.3954*** (0.0685)	0.1881* (0.0755)
ln(Tertiary Age Population)		0.6003* (0.2418)	0.6914** (0.2601)		0.7195** (0.2652)	0.6784* (0.2770)
Country FE	Yes	No	Yes	Yes	No	Yes
Time FE	Yes	No	Yes	Yes	No	Yes
<i>N</i>	2863	2863	2863	2863	2863	2863
<i>R</i> ²	0.324	0.011	0.329	0.372	0.027	0.377

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Robust standard errors in parentheses clustered at the country level.

Undergraduate enrollment is also negatively related to GDP per capita. As U.S. institutions are among the highest priced in the world, an increase in income decreases undergraduate enrollment. However, I find a positive relationship with graduate enrollment and GDP per capita which explains that foreign students in US graduate programs is a function of the resources available to these programs or the “supply side” of the graduate market- with opportunities that are likely to be determined by research/state funding and other institutional sources of support- demand for teaching assistants [Bound et al., 2009]. Although insignificant, inflation rate in the source country has a negative effect on enrollment decision for both undergraduate and graduate students. Higher inflation rate determines the changes in the purchasing power, eroding the currency value in the home country and affects foreign enrollment negatively. Unemployment rate in country

c has a significant positive effect on graduate foreign enrollment. Higher unemployment rate signifies that the economy is operating below full capacity. So, it can be explained by the fact that students are attracted towards more open labor markets in the U.S. and are willing to stay back in the U.S. after completion of their degree for higher returns in the future labor market. Hence, current period enrollment increases.

Table 4: Baseline Regression

	Undergraduate			Graduate		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Lagged Exchange Rate)	-0.0371 (0.0479)	0.0276** (0.0087)	-0.0379 (0.0477)	0.1048** (0.0372)	0.0549*** (0.0104)	0.1171** (0.0373)
ln(GDP per capita)		-0.0435* (0.0205)	-0.2223* (0.1027)		-0.0331 (0.0228)	0.1697 (0.0969)
ln(Inflation Rate)		-0.0655 (0.0743)	-0.1182 (0.0857)		0.0965 (0.1019)	-0.1209 (0.0949)
ln(Unemployment Rate)		0.1520* (0.0625)	0.0595 (0.0705)		0.3964*** (0.0687)	0.1887* (0.0756)
ln(Tertiary Age Population)		0.6010* (0.2418)	0.6860** (0.2606)		0.7187** (0.2653)	0.6886* (0.2772)
Country FE	Yes	No	Yes	Yes	No	Yes
Time FE	Yes	No	Yes	Yes	No	Yes
N	2858	2858	2858	2858	2858	2858
R^2	0.324	0.011	0.329	0.374	0.027	0.379

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Robust standard errors in parentheses clustered at the country level.

Increase in college-aged population is associated with a large increase in undergraduate and graduate foreign enrollment from the sending country by 0.6914% and 0.6784% respectively. This is consistent with [Rosenzweig et al., 2006] “constrained domestic schooling model”, students come to study in the U.S. in the undergraduate and graduate level for the lack of home country options. In Table 4, I use lagged exchange rate (one period lag) as robustness check because students’ decision can also depend on previous period exchange rate rather than the current period exchange rate. The results obtained for all the indicators remains similar.

The results in Table 5-8 represents regression results by classifying the sample into four income economic groups based on World Bank’s Atlas method. The four groups are- high income group, upper middle-income group, lower-middle income group and low-income group. Interestingly, foreign undergraduate enrollment decreases by 0.0525% for high income-group individuals with exchange rate fluctuations. This can be explained by the fact that they already come from a wealthy background and are not looking for better educational and labor market opportunities in the U.S. Although insignificant, the negative relationship between undergraduate enrollment and exchange rate holds true for upper-and-lower-income group sample explaining the fact that individuals are willing to invest in higher quality of education from an US institution for better human capital returns in the future. Or it might be due to openness/acceptance to diverse types

of educational experiences and unconventional learning strategies. But graduate enrollment is not sensitive to changes in prices of education and rises for every income group sample. The GDP per capita coefficient is negative and significant for both high-and-low-income group people indicating that changes in income affect undergraduate enrollment negatively. The results for the other indicators are mostly like the baseline regression results across all income groups.

Table 5: High Income Group Sample

	Undergraduate		Graduate	
	(1)	(2)	(3)	(4)
ln(Exchange Rate)	0.0525* (0.0215)	-0.8070* (0.3256)	0.0282 (0.0349)	1.0708* (0.5104)
ln(GDP per capita)	-0.0680 (0.0683)	-1.0458*** (0.3008)	0.0037 (0.0838)	0.3170 (0.3027)
ln(Inflation Rate)	-0.4169** (0.1366)	-0.4961** (0.1734)	0.2316 (0.1943)	-0.0181 (0.1867)
ln(Unemployment Rate)	0.9984*** (0.2639)	-0.2341 (0.3150)	1.3927*** (0.3038)	-0.0649 (0.4227)
ln(Tertiary Age Population)	-0.9241*** (0.2618)	-1.4071* (0.6852)	-0.8565* (0.4293)	-1.1693 (1.0252)
Country FE	No	Yes	No	Yes
Time FE	No	Yes	No	Yes
<i>N</i>	663	663	663	663
<i>R</i> ²	0.072	0.531	0.096	0.470

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Robust standard errors in parentheses clustered at the country level.

Table 6: Upper Middle Income Group Sample

	Undergraduate		Graduate	
	(1)	(2)	(3)	(4)
ln(Exchange Rate)	0.0480*** (0.0128)	-0.2423 (0.1263)	0.0730*** (0.0128)	0.1536 (0.1124)
ln(GDP per capita)	0.2519** (0.0809)	-0.0588 (0.1770)	0.2691*** (0.0707)	-0.2683 (0.1377)
ln(Inflation Rate)	0.0950 (0.1843)	0.2053 (0.1767)	-0.2046 (0.1642)	-0.1821 (0.1558)
ln(Unemployment Rate)	0.2066 (0.1102)	0.1750 (0.1495)	0.0616 (0.1121)	0.1911 (0.1503)
ln(Tertiary Age Population)	0.5490 (0.5200)	0.5475 (0.5932)	0.7104 (0.4946)	0.7457 (0.5674)
Country FE	No	Yes	No	Yes
Time FE	No	Yes	No	Yes
<i>N</i>	797	797	797	797
<i>R</i> ²	0.036	0.266	0.047	0.277

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Robust standard errors in parentheses clustered at the country level.

Table 7: Lower Middle Income Group Sample

	Undergraduate		Graduate	
	(1)	(2)	(3)	(4)
ln(Exchange Rate)	0.0015 (0.0138)	0.0470 (0.0264)	0.0681*** (0.0158)	0.0156 (0.0178)
ln(GDP per capita)	-0.0531 (0.0632)	0.0985 (0.1671)	-0.0107 (0.0646)	0.2326 (0.1679)
ln(Inflation Rate)	-0.0836 (0.1605)	-0.0799 (0.1641)	-0.1803 (0.1876)	-0.0937 (0.2257)
ln(Unemployment Rate)	-0.0536 (0.0873)	0.0876 (0.1058)	0.4040*** (0.1030)	0.2685* (0.1154)
ln(Tertiary Age Population)	1.0060* (0.4668)	1.0547* (0.4503)	1.2129* (0.4949)	1.1353* (0.4726)
Country FE	No	Yes	No	Yes
Time FE	No	Yes	No	Yes
N	896	896	896	896
R^2	0.019	0.348	0.043	0.430

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Robust standard errors in parentheses clustered at the country level.

Table 8: Low Income Group Sample

	Undergraduate		Graduate	
	(1)	(2)	(3)	(4)
ln(Exchange Rate)	-0.0385 (0.0253)	-0.0042 (0.1226)	-0.0696** (0.0243)	0.1198 (0.1512)
ln(GDP per capita)	-0.1416 (0.0729)	-0.5130* (0.2566)	0.1337 (0.0955)	0.3541 (0.2220)
ln(Inflation Rate)	0.0230 (0.1258)	0.0770 (0.1498)	0.2760 (0.1781)	-0.1722 (0.1812)
ln(Unemployment Rate)	-0.1430 (0.1174)	-0.1086 (0.1032)	0.4557*** (0.0928)	0.1448 (0.0825)
ln(Tertiary Age Population)	0.1377 (0.2661)	0.7025 (0.4221)	0.5885 (0.3567)	0.6363 (0.3540)
Country FE	No	Yes	No	Yes
Time FE	No	Yes	No	Yes
N	507	507	507	507
R^2	0.018	0.250	0.051	0.343

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Robust standard errors in parentheses clustered at the country level.

8 Conclusion

Economists have not yet investigated how an international student decision are affected in real time by her home-country economy. Previous work mainly focused on how international students are selected and how they assimilate over time. Other research work discusses about internationalization of foreign-born students in the U.S. universities focusing to only doctoral candidates. In contrast, this paper investigates the role of home-country determinants of overseas students' economic behavior. I use exchange rates as the main deterministic factor for enrollment decision in an educational institute in the U.S. With a real appreciation of the U.S dollar, the expenses to be incurred by an international student in terms of their home country's currency on the choice of education to be obtained from an U.S. educational institute rises. And hence a negative relationship between enrollment and the relative cost of attending a U.S institution is expected.

Based on my analysis, I find a negative relationship between exchange rates and undergraduate enrollment which indicates that foreign students are sensitive to changes in prices of education caused by fluctuations in exchange rates. But the estimate is insignificant. However, the same relationship doesn't hold true for graduate enrollment indicating that foreign students are less sensitive to changes in prices of education caused by exchange rates volatility. The results make sense because graduate students are normally funded through assistantships or fellowships, while undergraduate students have to bear the entire cost of education.

To further establish and interpret my results, I included GDP per capita as a proxy for home country income, inflation rate, unemployment rate prevailing in each country. I find that with increase in GDP per capita undergraduate enrollment decreases and that is what is expected given the higher education price in the U.S. educational institutes. GDP per capita is positively related to foreign graduate enrollment indicating that students' in the home country prefer to study in the U.S. in the graduate level irrespective of positive changes in their income because student's in the graduate level are normally funded and their own income doesn't affect the enrollment decisions a lot. It is also seen that the students' decisions are driven by the price of their consumption basket in each country. The rate of inflation in a country can have a major impact on the value of the country's currency and the rates of foreign exchange it has with the currencies of other nations. However, inflation is just one factor among many that combine to influence a country's exchange rate. Rising inflation rate in the home country affects both graduate and undergraduate enrollment negatively. Higher unemployment rate in the source country has a positive effect on enrollment in the host country at both the levels of education indicating that students are more attracted towards the labor market opportunities with higher wage premiums compared to the source country.

Using tertiary aged population to measure the home country options for higher education, my results shows that the coefficient is modest for undergraduate and graduate enrollment regressions, indicating that

an increase in college- aged population is associated with increase in graduate foreign enrollment from the sending country. This is consistent with previous literature addressing that students come to study in the U.S. in the graduate level for the dearth of home country options. The effects of this variation are magnified for students from countries where the supply of higher educational opportunities comparable to U.S. is likely to be constrained, as measured by the number of top universities located in students' home countries. I further divide the countries based on different income groups to test for the heterogeneous effects. The results were more or less consistent with my baseline regression results.

My study has several limitations and the most important is omitting relevant exogenous variables that is correlated with international enrollment mobility causing biases and inconsistent estimators in the regression results. However, this bias is due to the data barriers. I am unable to collect data on the average living expenses and cost of education in the host country by different source country level during the given time period I used in my analysis. That leaves out huge financial factors. My study lacks data to capture other sociological, environmental, technological, political, cultural, demographic and health related factors in the country level. I have only used some economic indicators to establish my model and results and controlled for time and country dummies.

Implications for the U.S. higher education market are multi-fold. First, while substantial and persistent rates of economic growth 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, foreign demand is expected to abate. Third, 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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Appendix A.

Table A1: Country and #Years used in my analysis

Country	# Years	Country	# Years	Country	# Years
Afghanistan	19	Georgia	19	Niger	19
Albania	19	Germany	19	Nigeria	19
Algeria	19	Ghana	19	Norway	19
Angola	19	Guatemala	19	Pakistan	19
Argentina	19	Guinea	19	Papua New Guinea	19
Armenia	19	Guinea-Bissau	19	Paraguay	19
Australia	19	Guyana	19	Peru	19
Azerbaijan	19	Haiti	19	Philippines	19
Bangladesh	19	Honduras	19	Poland	19
Belarus	19	Hungary	19	Romania	19
Benin	19	Iceland	19	Russian Federation	19
Bhutan	19	India	19	Rwanda	19
Bolivia	19	Indonesia	19	Samoa	19
Bosnia and Herzegovina	19	Iran	19	San Marino	19
Botswana	19	Iraq	19	São Tomé and Príncipe	19
Brazil	19	Israel	19	Senegal	19
Brunei Darussalam	19	Jamaica	19	Serbia	19
Bulgaria	19	Japan	19	Seychelles	19
Burkina Faso	19	Kazakhstan	19	Sierra Leone	19
Burundi	19	Kenya	19	Singapore	19
Cabo Verde	19	Kiribati	19	Slovenia	6
Cambodia	19	Korea, Republic of	19	Solomon Islands	19
Cameroon	19	Kuwait	19	Somalia	8
Canada	19	Kyrgyz Republic	19	South Africa	19
Central African Republic	19	Lao	19	Sri Lanka	19
Chad	19	Latvia	13	Suriname	19
Chile	19	Lesotho	19	Sweden	19
China, P.R.: Hong Kong	19	Liberia	19	Switzerland	19
China, P.R.: Mainland	19	Libya	19	Syrian Arab Republic	17
Colombia	19	Lithuania	14	Tajikistan	19
Comoros	19	Madagascar	19	Tanzania	19
Congo, Democratic Republic	19	Malawi	19	Thailand	19
Congo, Republic	19	Malaysia	19	Togo	19
Costa Rica	19	Maldives	19	Tonga	19
Côte d'Ivoire	19	Mali	19	Trinidad and Tobago	19
Croatia	19	Malta	7	Tunisia	19
Cyprus	7	Mauritania	19	Turkey	19
Czech Republic	19	Mauritius	19	Uganda	19
Denmark	19	Mexico	19	Ukraine	19
Dominican Republic	19	Moldova	19	United Kingdom	19
Egypt	19	Mongolia	19	Uruguay	19
El Salvador	19	Montenegro	19	Uzbekistan	8
Eritrea	19	Morocco	19	Vanuatu	19
Estonia	10	Mozambique	19	Venezuela	17
Eswatini	19	Myanmar	19	Vietnam	19
Ethiopia	19	Namibia	19	Yemen	19
Fiji	19	Nauru	19	Zambia	19
French Polynesia	19	Nepal	19	Zimbabwe	8
Gabon	19	New Zealand	19		
Gambia	19	Nicaragua	19		