International Students in the United States: A Statistical Analysis

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Executive Summary

In the past 20 years, the number of students receiving an education in the United States has tripled, with Chinese students being the main driving force in the most recent years. A total of 235,000 students came from China in 2012, a 21 percent increase compared to a combined average of 7 percent increase from other countries with the most international students coming into the U.S., including India, South Korea, Saudi Arabia, and Canada.

Foreign students contribute a total of $24 billion annually to the U.S. economy from tuition and living related expenses, with as many as two-third of the international students paying full college tuition. In the 2012-2013 school year, a total of 819,644 students came from abroad; however, that only makes up 4 percent of the total student body in the United States, leaving sizable room for growth. Yet, 70% of those international students are concentrated in only about 200 schools, leaving schools with decreasing government subsidies and flattening tuition out in the cold. The main reason for this concentration in a few schools is that most of international students' preference are toward degrees in business and science, with as many as 50% of Chinese students focus in either business or engineering, leading to aggregation of students in certain universities that offer those programs.

In this report, we identified gross domestic product, ranking of universities at home country, and globalization as the main factors that are driving the number of foreign students to study in the United States. They together explained 37.4% of the number of international oversea in the United States.

GDP is the main factor that predicts the number of students with students receiving an education in the U.S. When real GDP per capital increases by 1%, the number of international students studying abroad is predicted to increase by 0.85%.

Besides GDP per capita, international students are often seeking U.S. universities with higher quality than their home universities based on the world's university ranking. Top university in home country has a negative effect in foreign student's willingness to come to the United States. Countries with top university compared to countries without top university will decrease the number of international students from that country by 63.6%.

In our analysis, trend to globalization has helped the number of international students studying abroad in the United States to soar every year regardless of their country GDP, or quality of universities at home. On average, there is an 1% increase in international students for all countries studying in the U.S. every year. In our predictive model, there will be an increase of 6.16% to 14.3% increase in the number of international students coming to the United States.

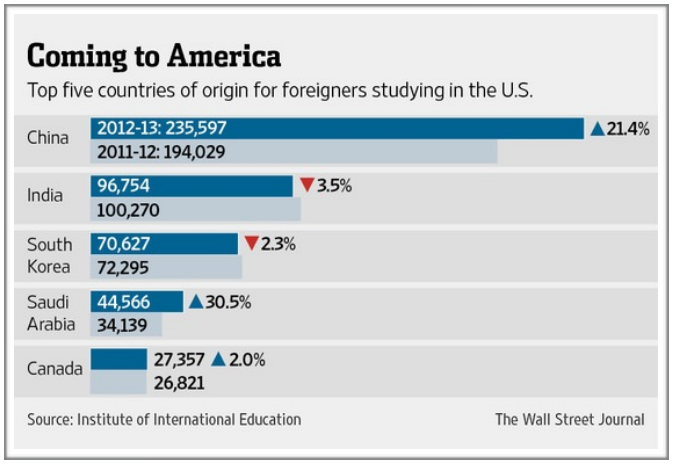
However, the rest of the data will still depend on other factors such as Gini coefficient, the country's demographics, and willingness to study abroad. In order to attract more international students, it is not only crucial for the universities in the United States to understand the quantitative aspects of what is driving the international students to the U.S., but also to figure out the qualitative attribute to what makes up their final decision to study abroad and to choose your university.

An Analysis on the International Students in the United States

The Main Issue

A recent study administered by the Institute of International Education and the State Department's Bureau of Educational and Cultural Affairs indicates that the number of international students studying abroad in the United States is at a record high. Foreign students contribute a total of $24 billion annually to the U.S. economy from tuition and living related expenses, with as many as two-third of the international students paying full college tuition.

In the 2012-2013 school year, a total of 819,644 students came from abroad; however, that only makes up 4 percent of the total student body in the United States, leaving sizable room for growth. Yet, 70% of those international students are concentrated in only about 200 schools, leaving schools with decreasing government subsidies and flattening tuition out in the cold.



The main reason for this concentration in a few schools is that most of international students' preference are toward degrees in business and science, with as many as 50% of Chinese students focus in either business or engineering, leading to aggregation of students in certain universities that offer those programs.

The five universities with the most international students last year were:
1)University of Southern California
2)University of Illinois Urbana-Champaign
3)Purdue University
4)New York University
5)Columbia University

In this report, we identified gross domestic product, ranking of universities at home country, and globalization as the main factors that are driving the number of foreign students to study in the United States.

With decreasing numbers of high school students graduating in the U.S. and increasing competition from university program offered outside the U.S., it is critical to understand what is causing international students to study in the United States in order to benefit from the upsurge in the number of international students as well as the value that they bring both culturally and financially to the university.

Relationship Between Number of International Students and Country GDP

Understanding the Explanatory Variables

Using regression analysis will estimate how the number of international students are affected by (1)the country's real gross domestic product(real GDP), (2)whether the country has a university ranked in the world's top 200, and (3)the year that the data is collected, ranging from the year 1964 to the year 2009.

Gross Domestic Product

GDP data are collected from World Penn Table PWT7.0, with data ranging from 1950 to 2009, using 2005 as reference year. GDP data used are PPP-converted GDP per capita, derived from growth rates of C,G, and I, at 2005 constant prices.

Top University Ranking

University ranking are collected from the Academic Ranking of World Universities(ARWU) administered by the Shanghai Jiao Tong University. Data published by the ARWU on its website ranges from the year 2003 to year 2013. The 2003 to 2009 data is used to according with the corresponding year in this research. However, since university ranking data were not available through 1964 to 2002, 2003 data were instead used to assign top university for the rest of the years in the dataset. This includes data for 1964, 1969, 1974, 1979, 1984, 1984, 1989, 1994, 1999, 2000, 2001, and 2002.

Year

Each country has 18 years of data in this research, ranging from 1964 to 2009. Although GDP data were readily available for most countries during this time period, the data for number of international students studying abroad in the United States collected by Institute of International Education(IIE) were not available every year. More specifically, IIE's data from 1964 to 1999 were in five year increments: 1964, 1969, 1974, 1979, 1984, 1989, 1994, and 1999. The rest of years that have consecutive data are in the year 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2009.

Relationship Between Number of International Students and Country GDP
Data Used in Determining the Regression Line

There are a total of 2960 observations in the regression. Some country-years were missing due to unavailable data in either the number of international students studying in the U.S. or GDP data for the country with a year. Since there are a total of 3258 observations in the data collected, 298 observations were missing from the regression. This amounts to 9% of the data being missing and should not affect the results of this research.

Countries

This research includes data collected from 181 countries around the world. Below is the list of countries used in this report:

Afghanistan	China	Hungary	Moldova	Spain
Albania	Colombia	Iceland	Mongolia	Sri Lanka
Algeria	Comoros	India	Morocco	St. Kitts and Nevis
Angola	Costa Rica	Indonesia	Mozambique	St. Lucia
Antigua and	Côte d'Ivoire	Iran	Namibia	St. Vincent
Barbuda	Croatia	Iraq	Nepal	Sudan
Argentina	Cuba	Ireland	Netherlands	Suriname
Armenia	Cyprus	Israel	New Zealand	Swaziland
Australia	Czech Republic	Italy	Nicaragua	Sweden
Austria	Denmark	Jamaica	Niger	Switzerland
Azerbaijan	Djibouti	Japan	Nigeria	Taiwan
Bahamas	Dominica	Jordan	Norway	Tajikistan
Bahrain	Dominican	Kazakhstan	Oman	Tanzania
Bangladesh	Republic	Kenya	Pakistan	Thailand
Barbados	Ecuador	Kiribati	Palau	East Timor
Belarus	Egypt	Kuwait	Panama	Togo
Belgium	El Salvador	Kyrgyzstan	Papua New Guinea	Tonga
Belize	Equatorial Guinea	Laos	Paraguay	Trinidad and
Benin	Eritrea	Latvia	Peru	Tobago
Bermuda	Estonia	Lebanon	Philippines	Tunisia
Bhutan	Ethiopia	Lesotho	Poland	Turkey
Bolivia	Fiji	Liberia	Portugal	Turkmenistan
Bosnia and	Finland	Libya	Qatar	Uganda
Herzegovina	France	Lithuania	Romania	Ukraine
Botswana	Gabon	Luxembourg	Russia	United Arab
Brazil	Gambia	Macau	Rwanda	Emirates
Brunei	Georgia	Macedonia	Samoa	United Kingdom
Bulgaria	Germany	Madagascar	Saudi Arabia	Uruguay
Burkina Faso	Ghana	Malawi	Senegal	Uzbekistan
Burundi	Greece	Malaysia	Seychelles	Vanuatu
Cambodia	Grenada	Maldives	Sierra Leone	Venezuela
Cameroon	Guatemala	Mali	Singapore	Vietnam
Canada	Guinea	Malta	Slovakia	Yemen
Cape Verde	Guinea-Buissau	Marshall Islands	Slovenia	Zambia
Central African	Guyana	Mauritania	Solomon Island	Zimbabwe
Rep.	Haiti	Mauritius	Somalia	
Chad	Honduras	Mexico	South Africa	
Chile	Hong Kong	Micronesia	South Korea	

Relationship Between Number of International Students and Country GDP

Regression Result and Method Used

In order to find the best predictive multiple regression line, number of international students was converted into number per capita to match with real GDP per capita. A dummy variable was created for a country with university ranked in the top 200. Year was assigned a value of 0 to 35 based on time series.

The following variables were created:

- **Students Per Capita(y-variable)** was calculated as number of international students divided by the total population of the country in the corresponding year. Using students per capita in the regression also counts for the fact that countries with more population will have higher number of students studying abroad. For example, Chinese and Indian represent a large percentage of international students in the U.S.; however, China and India are also the most populous countries in the world. By using students per capita, the regression will not be affected by the total population of that country. This will yield a more realistic regression line.

- **Top University(x-variable)** is a dummy variable that has either a value of 0 or 1 assigned to each observation. 0 represents that the observation, in this case, a country, does not have an university ranked in top 200. And 1 represents that the observation has at least one university ranked in the top 200. This dummy variable does not differentiate between country with more universities or one university in the top 200 list. For example, even though Japan has more top universities than Spain does, they are treated the same in this regression.

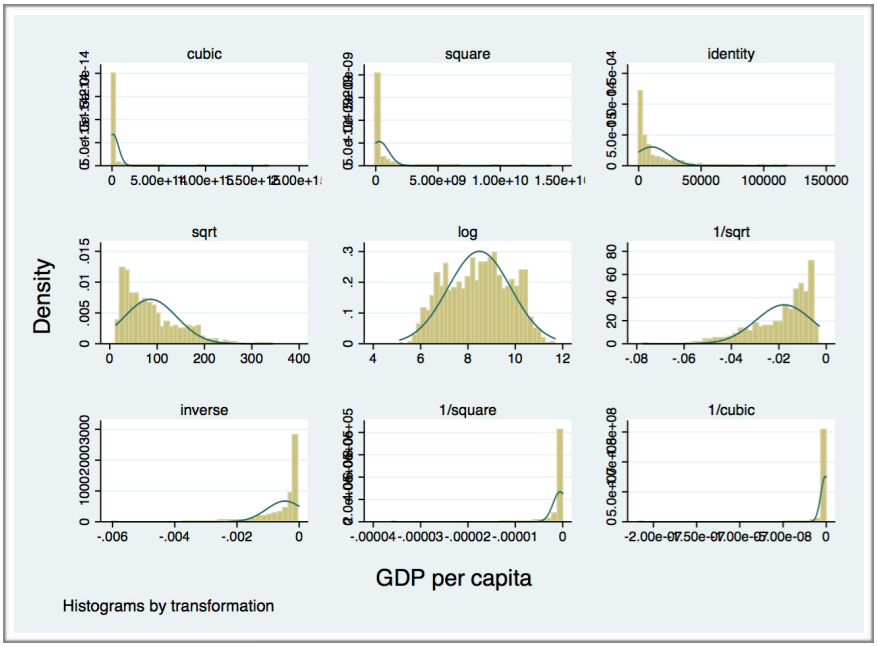
- **Year(x-variable)** is assigned as a different value using time-series instead of the actual year. Starting with 1964 as the base year 0, each year after 1964 is assigned the value of 'Present Year-1964'. So 1999 would have a dummy variable of 35 and etc.

Finally, the variables studentspercapita and GDPpercapita are adjusted to be a function of natural log. Natural log tends to linearize a series of data in order to reduce heteroscedasticity.

Heteroscedasticity refers to the unequal and wide range of variability in a given variable, making it harder to analyze and predict with a regression line. By using natural log for studentspercapita

and GDPpercapita, both outputs become more linearized, allowing the dependable variable to have better predictability by the independent variables.

The graph below shows that real GDP per capita follows a normal distribution under the natural log functions.



Simple Data Analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
lnstudents~a	3056	-2.414803	1.767257	-11.84376	2.700266
lngdpperca~a	2999	8.486947	1.326527	5.115548	11.68495
topunivers~y	3258	.1209331	.3260995	0	1
yeardummy	3258	30.27778	13.91378	0	45

The above table gives summary statistics for the variables used. There are no concern of skewness or any extreme values, since students per capita and real GDP per capita were already converted to natural log function. Topuniversity is dummy variables so it has a minimum of 0 to indicate country has no top university. Year range from 0 to 45 starting from the year 1964 as explained by the earlier section.

Multiple Regression Equation

The regression equation is estimated as:

ln(studentpercapita) = 0.849ln(gdppercapita) - 1.01topuniversity + 0.01yeardummy - 9.819

(t-stats in parentheses) (39.56) (-12.10) (4.91) (-54.97)

The t-statistics of the variables in the above equation indicate that all variables are statistically significant at the 95% level. Correspondingly, the p-value test rejects the null hypothesis that these variables do not make a difference to the dependent variable lnstudentspercapita with

Source	SS	df	MS
Model	3395.04551	3	1131.68184
Residual	5672.91564	2956	1.91911896
Total	9067.96115	2959	3.06453571

Number of obs	2960
F(3, 2956)	589.69
Prob > F	0.0000
R-squared	0.3744
Adj R-squared	0.3738
Root MSE	1.3853

lnstudentspe~a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lngdppercapita	.8492697	.0214668	39.56	0.000	.8071783	.8913612
topuniversity	-1.010803	.083546	-12.10	0.000	-1.174617	-.8469888
yeardummy	.0102514	.0020861	4.91	0.000	.0061611	.0143417
_cons	-9.818691	.1786278	-54.97	0.000	-10.16894	-9.468443

99.99% confidence.

Note: constant is not interesting here because GDP per capita is rarely equal to zero.

Adjusted R-Squared

R-Squared is one of the most important value to look for when finding the best predictive equation. R-squared is defined as the sum of squares of the regression(SSR) divided by the sum of squares total(SST). With a R-squared of 0.374, this indicates that 37.4% of the variable variation in ln(studentspercapita) can be explained by the three explanatory variables used in the model.

Real GDP Per Capita

Gross domestic product(GDP) is the main factor that predicts the number of students with students receiving an education in the U.S. Since most international students do not qualify for

grants from the U.S. government, the standard living costs in the U.S. and the tuition act as the main barriers for students who want to study in the United States. GDP measures the total dollar of all goods and services produced over a year, thus acting as a proxy for the size of the economy. Since a healthy economy usually is a sign for higher wages and higher standard of living, a country with higher GDP suggests the citizen of that country is financially better off, makes living in the United States and paying full college tuition less burdensome. Therefore, overall GDP is one of the primary predictors of the number of students expected to come to the United States. China is the second largest economy in the world that averages double digit growth in GDP for the past few years and is one example of a country with large growing number of students coming to the U.S. year over year.

The regression results were in line with expectations and are quite intuitive to interpret. The change in real GDP per capita has the most significant effect in predicting the change in number of international students per capita coming from a certain country. Ln(gdppercapita) has a positive coefficient value which indicates that a higher GDP per capita leads to more students studying abroad in the United States. More specifically, when real GDP per capital increases by 1%, the number of international students studying abroad is predicted to increase by 0.85% holding other variables(topuniversity, yeardummy) constant. In a multiple regression, every coefficient is the effect that an independent variable has on the dependent variable while holding other variables unchanged.

To determine how much the coefficient is going to affect the dependent variable, we look at the magnitude of the coefficient in changing the standard deviation of the dependable variable. When increasing ln(gdppercapita) by one standard deviation, it increases the dependent variable ln(studentspercapita) by 0.642. Since one standard deviation of ln(gdppercapita) is 1.33 which multiplied by the coefficient 0.849 equals to 1.13, it equals to 64.2% of 1.76(one standard deviation of the dependent variable). This is quite a huge movement.

In a regression, when the t-statistics is higher than 1.96, it is significant at the 95% level. Because the t-statistics is 39.56 for ln(gdppercapita), it is safe to assume that 95% of the time, the percentage change in international students with a 1% change in real GDP per capita will fall within ± two standard errors(0.021) of the coefficient, anywhere between 0.81% and 0.89%.

Top University

GDP data determines the likelihood that a student will study abroad based on their standard of living. Worldwide university ranking determines whether a student will have enough incentives

to seek for an education in the United States. The increasing competition from other universities outside the U.S. also has an influence on the number of international students coming to the United States.

A foreign country with growing GDP can be a double edged sword for the international enrollment at U.S. universities. While a country with higher and growing GDP is likely to send more students to the United States, it is likely that its educational system is also improving, which to a certain extent might deter students from leaving their home country altogether simply because they are now surrounded by international students without leaving home. Notably, many South Korean students have opted for programs in China instead of the U.S. not only for its cost and close proximity, but they also view the quality of education as equivalent to that of the U.S. counterparts.

New York University recently opened a campus in Shanghai to attract local Chinese students who are increasingly skeptical of the value of going overseas. When the universities in China have been surging quickly in the world university ranking and businesses are continuously moving into China, students start to think about the cost and benefit of a U.S. education. Duke University is also expected to offer graduate program in city near Shanghai in 2014 after New York University announced its plan to also open its Juilliard School in Tianjin in addition to its Shanghai campus. Our research showed that more top universities a country has, the less likely the student would want to study abroad. The university does not even have to be as high quality as the universities in the U.S., but just good enough so that the benefits of staying in their home country outweighs the benefits of going abroad. This has the opposite effect of the GDP when it comes to international enrollment for U.S. universities.

The coefficient on topuniversity was negative at -1.01 with a t-statistic of -12.10. Since the dependent variable is denoted as a function of natural log but not the independent variable, the coefficient result can be interpreted as countries that have at least one top university will decrease the number of international students from that country by 63.6% holding other variables constant. Although the sign of this coefficient is negative as previously expected, the suggested result seems to be too extreme. Just because a country suddenly has at least one university that is ranked in the world's top 200 compared to none in the previous year, it is highly unlikely that the number of international students from the same country for next year will drop by more than 60%.

A better explanation to this result is that this is caused by missing variable bias. The missing variable bias can result from other variables that are not included in the regression equation that happen to be highly associated with the testing variable. Something to think about is what other factors could have contributed to the main difference between countries that have top universities vs. countries that do not have top universities in the dataset besides GDP per capita. In this case, the coefficient is the effect of the top university has on the students per capita by holding GDP per capita and year constant. When examining the data further, there is some evidence that countries with at least one top university tends to have more than one top university in the top 200. Since topuniversity does not differentiate between having one university or many universities in the top 200, it is likely that the countries assigned with a dummy variable of 1(has at least one top university) are much more developed in their education system than the other countries, thus having more universities in the top 200 ranking. This suggests that when a country's overall economy or educational system is more developed, it will almost invariably be assigned a dummy variable of 1. Then the regression result would be similar to comparing international students per capita between countries that are more developed vs. countries that are less developed. Explanation using the previous result would be countries that are more developed will send fewer students compared to less developed to the United States holding other variables constant.

However, as to why developed countries are sending fewer international students per capita in the United States might not be a very straightforward answer. To analyze further, in the earlier years of the dataset(from 1964-1999), countries with fuller and more developed educational system were in the western part of the world where the national language is already English. When considering the reason international students study abroad in the United States is to learn English, it is logical that the countries sending relatively fewer number of students per capita is mostly from the western world(dummy variable of 1). Therefore, a country and a year with a dummy variable of 1 happens to be indicating that is it western country that is more developed where the national language is already English and also has more top ranked universities. Instead of testing for the effect of high quality universities in a country, it is measuring the effect of a western developed county vs. the rest of the world holding GDP per capita constant.

Year

With globalization, it is not difficult to predict that more and more international students are studying abroad worldwide. In the past 20 years, the number of students receiving an education in the United States has tripled, with Chinese students being the main driving force in the most recent years. That number has since rebounded after the number of international students coming

into the United States dropped after the Sept. 11 attacks due to visa issues. A total of 235,000 students came from China in 2012, a 21 percent increase compared to a combined average of 7 percent increase from other countries with the most international students coming into the U.S., including India, South Korea, Saudi Arabia, and Canada.

As the regression result indicates, on average, there is an 1% increase in international students studying in the U.S. controlling for the country's GDP per capita or improvement in education. Countries that have the same real GDP per capita year over year will send 1% more international students to the United States every year. Since this research is being done in 2013, we are 95% certain that in the year 2014, there will be an increase of 6.16% to 14.3%(± two standard errors of 0.002) in the number of international students coming to the U.S. if ln(gdppercapita) and the number of countries with top universities do not change.

Top 10 Countries of Origin for Foreign Students, 2010/2011

Rank	Place of Origin	Number of Students	% Share of Total
1	**China**	**157,558**	**21.8**
2	**India**	**103,895**	**14.4**
3	**South Korea**	**73,351**	**10.1**
4	Canada	27,546	3.8
5	**Taiwan**	**24,818**	**3.4**
6	Saudi Arabia	22,704	3.1
7	**Japan**	**21,290**	**2.9**
8	**Vietnam**	**14,888**	**2.1**
9	Mexico	13,713	1.9
10	Turkey	12,184	1.7

Top 10 Asia Pacific Study Abroad Destinations, 2009/2010

Rank	Destination	Number of Students	Year to Year % Change
1	China	13, 910	1.7
2	Australia	9,962	-10.6
3	Japan	6,166	6.6
4	India	3,884	**44.4**
5	New Zealand	3,113	**41.1**
6	South Korea	2,137	3.6
7	Thailand	1,231	-15.8
8	Hong Kong	1,196	3.5
9	Taiwan	850	**42.4**
10	Singapore	841	**37.5**

Data Source: 2011 Open Doors Report, IIE

External Factors Outside of the Regression Model

Possible Confounding Factors

Although the statistical data has suggested the above finding, there is the need to address the possible problems with this regression model. There are some important factors that might have impacted the final result but were not accounted for in this model due to the lack of available data. For this reason, it may have impeded our regression equation from getting the most accurate results and implications.

Confounding Variables

In the real world, there are countless reasons as to why students from abroad will come to the U.S. for their education besides their countries' real GDP. Although using GDP per capita can help minimize the effect and control for the population in different countries, it cannot capture the wealth distributions and level of income inequality in a country. Factors such as this will affect the result of this research so we will address these factors here:

- **Gini Coefficient**

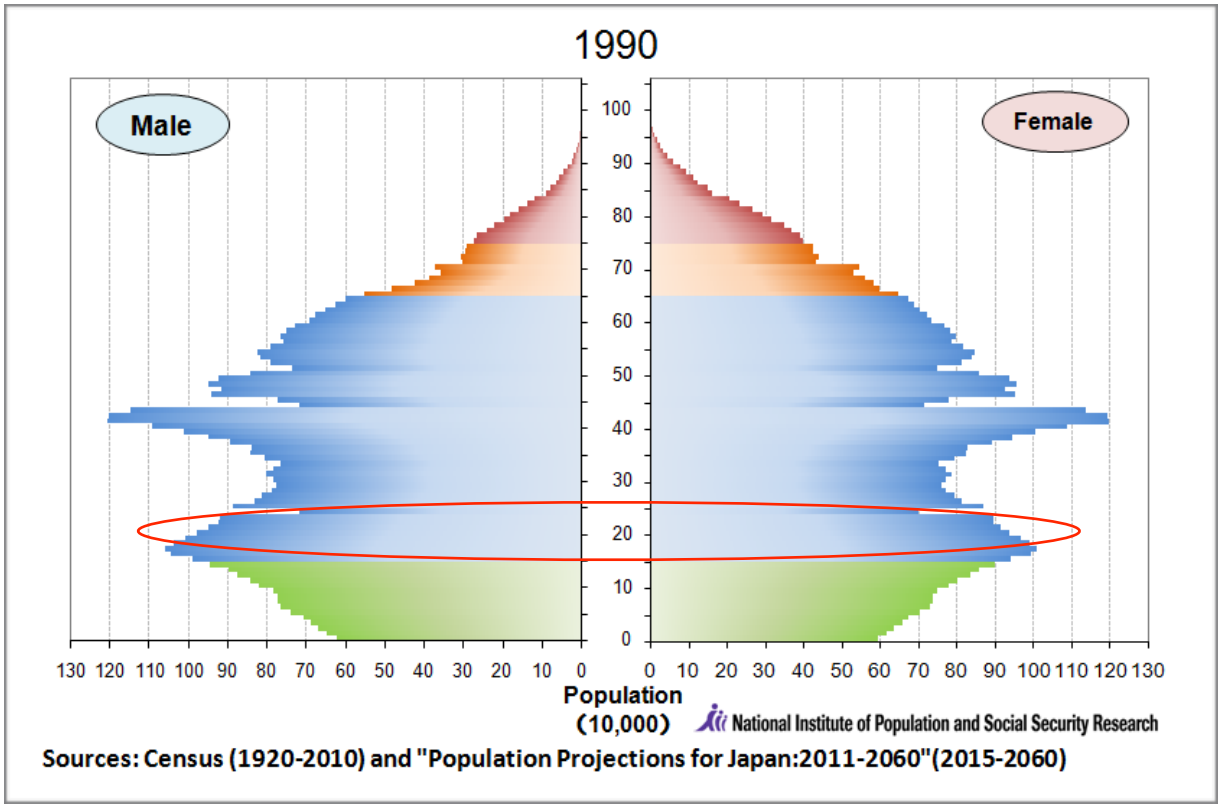
  This will have a direct influence on the coefficient and significance of the GDP per capita variable. Since Gini coefficient(with coefficient of 0 being perfect equality and 1 being perfect inequality) is an important gauge of income distribution in a nation, if this variable were included in the regression line, it would help GDP per capita to capture a more realistic look on the economic condition in a country. When comparing countries with higher GDP per capita to lower GDP per capita, it is expected that country with higher GDP per capita would have more families per capita that are able to afford education in the United States. In this case, if the Gini coefficient happens to be rising faster than the country's GDP per capita, high GDP per capita actually indicates that the average family in the country is earning relatively less income, causing the number of international students to rise more slowly or even to decreases despite the fact that the country's GDP per capita is higher.

  If Gini coefficient were to be included in the multiple regression, it would have a negative correlation with lnstudentspercapita and lngdppercapita's coefficient is likely to be greater than 0.849.

- **Demographics**

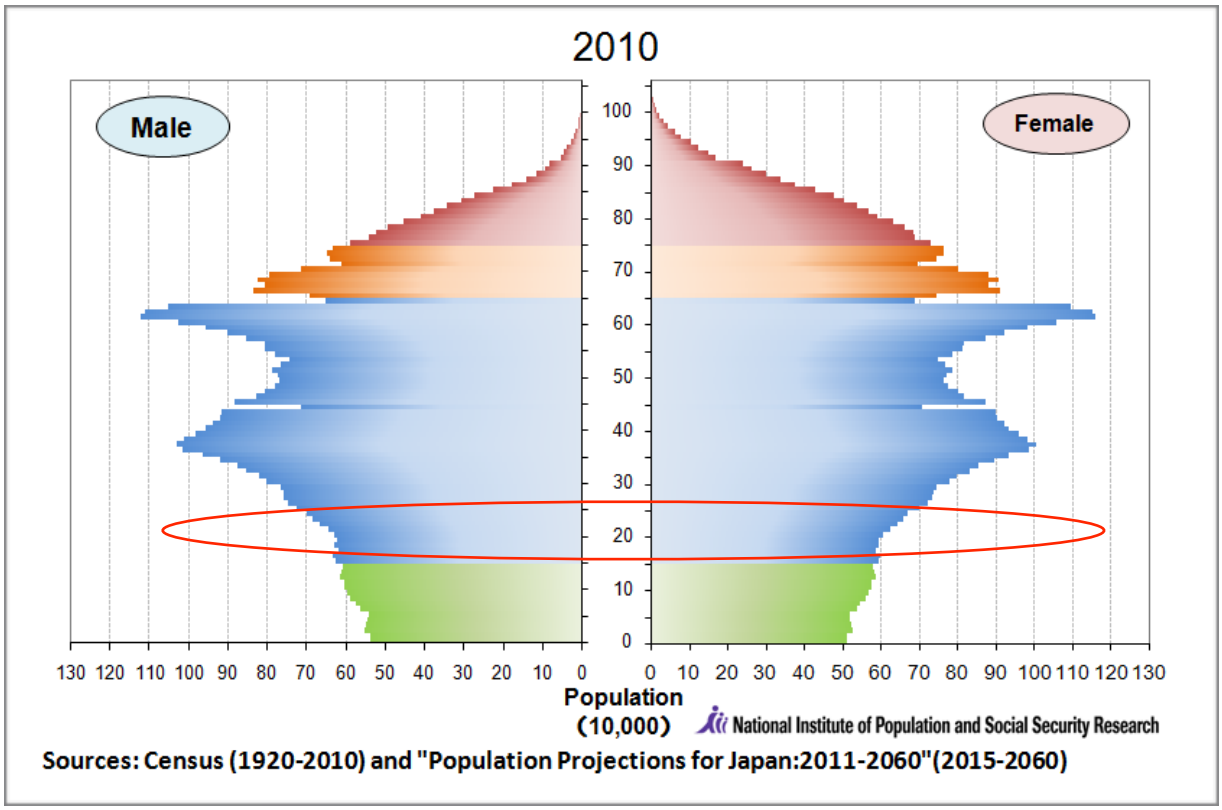
  Data such as the average age of population and the make up of population are two important factors to consider when analyzing the data. Since the age population between 18 and 22 is the preliminary age group that are coming into the United States to study, it is critical to examine the percentage of population that fall within certain population groups in order to understand and use the data better.

  Below is an example of the shift in demographics for population in Japan in the year 1990



and year 2010. In the data, although Japan's GDP per capita has steadily increased over time, up from GDP per capita of 26,324 in 1989 to 30,088 in 2009, number of students per capita studying in the United States from Japan has since decreased from 0.242 to 0.195(absolute number is 29,840 students vs. 24,842 students). In this example, it is not that the GDP per capita has a negative impact on Japan's willingness to study abroad, but rather it is that there are smaller percentage of population and fewer number of people in 2010 that are in need of an education compared to 1990.

Furthermore, by analyzing the age pyramid shown above, it is plausible to say that the number of students from Japan within the next decade is not likely to increase because of the low birth rate and smaller percentage of population that fall in the 1 to 10 age group.



In our analysis, trend to globalization has helped the number of international students studying abroad in the United States to soar every year regardless of their country GDP, or quality of universities at home. On average, there is an 1% increase in international students for all countries studying in the U.S. every year. In our predictive model, there will be an increase of 6.16% to 14.3% increase in the number of international students coming to the United States. Since the current number of international students only makes up 4% of the total student body in the United States, there are still room for growth and improvement for enrollment at any given university.

However, it remains critical that the universities in the United States be aware of their competition by traveling and spending their marketing and expansion cost in regions or countries that matter the most such as China, India, and South Korea where GDP is growing the fastest among the world. Those countries combined an average of 7 percent increase in number of students in 2012 while China alone grew 21.4% in to a total of 235,597 students in the U.S. In the regression, the magnitude of the GDP per capita is quite large. One standard deviation of GDP per capita accounts for 64.2% of the standard deviation in students per capita.

Besides GDP per capita, international students are often seeking U.S. universities with higher quality than their home universities based on the world's university ranking. Top university in home country has a negative effect in foreign student's willingness to come to the United States. Countries with top university compared to countries without top university will decrease the number of international students from that country by 63.6%. Therefore, amid competition, universities like New York University or Duke University planned to open campus in the East Asia region to lure students from overseas without having to come to the United States.

Some other universities have recently implemented different strategies to attract international students in hope to fill up their empty seats amid the decreasing number of domestic students and the increasing number of U.S. students choosing to go abroad for their college education. At Northern State in Aberdeen, they have eliminated the application fee for students who want to apply to their college. Some colleges have introduced Early Action in addition to their Early Decision program that allows students to receive early notification of a non-binding admission to their colleges in the early December.

GDP, globalization, quality of university at home together explained 37.4% of the number of international oversea in the United States. However, the rest of the data will still depend on other factors such as Gini coefficient, the country's demographics, and willingness to study abroad. In order to attract more international students, it is not only crucial for the universities in the United States to understand the quantitative aspects of what is driving the international students to the U.S., but also to figure out the qualitative attribute to what makes up their final decision to study abroad and to choose your university.

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