

Who Trains the Future?

How U.S. competitiveness for Chinese undergraduate students has evolved over time

Jacob Feldgoise

Department of Engineering and Public Policy, Carnegie Mellon University

U.S. higher education institutions' (HEIs) ability to attract Chinese students will likely shape the future of U.S. international relations with China, as well as both countries' economies and innovation enterprises. A substantial literature on international talent flows documents how the supply of foreign students to U.S. schools has changed over time, and the causal implications thereof. However, scholars have primarily focused on understanding the flow of students to U.S. graduate education programs—PhD programs in particular—ignoring the largest group of international students in the United States: undergraduates. In this study, the author leverages data from the Institute of International Education (1997-2018), the Chinese Ministry of Education (1996-2018), and the U.S. Department of Homeland Security's Student and Exchange Visitor Information System (2005-2018) to determine the proportion of Chinese undergraduate students enrolled at U.S. HEIs. The author finds that while the proportion of Chinese undergraduate students enrolled at U.S. HEIs (all fields) rose from 2008 to 2017, the proportion of engineering students only rose until 2014, after which it stagnated. In contrast, the proportion of Chinese undergraduate students enrolled in U.S. social science programs increased over the entire period (2008-2017). The causal factors behind the 2008 increase in overall Chinese student enrollment in the U.S. are difficult to determine due to the simultaneous increased affordability of U.S. higher education (due to rising Chinese household incomes and appreciation of the Yuan) and loosening U.S. immigration policies (specifically a U.S. June 2005 extension of Chinese students' visa validity from six months to one year). Further research is needed to understand why the proportion of Chinese undergraduates enrolled in U.S. engineering programs stagnated while the same proportion for social sciences has continued to rise. Explanations might include field-specific discrepancies with respect to job market access and salaries in China or that students in social sciences are disproportionately attracted to the open academic environment at U.S. HEIs.

Introduction

To the extent that immigrants are an important input to U.S. innovation and productivity (Khanna and Lee 2018, Hunt and Gauthier-Loiselle 2008, Moser et al. 2014, Doran and Yoon 2020, Burchardi 2020, Kerr et al. 2016, Brown et al. 2019), and that foreign undergraduate students stay for graduate school or transition to the U.S. labor market (Baer 2018, Baer and Marte 2020, U.S. Immigration and Customs Enforcement 2020, Ruiz 2014), U.S. higher education institutions' (HEIs) competitiveness for Chinese students will likely have implications for the future of the U.S. economy and innovation enterprise. This motivates the author's aim to understand the forces that could increase or decrease U.S. HEIs' competitiveness for Chinese students. A substantial literature on talent flows already documents how the flow of international students to U.S. schools has changed over time. However, scholars have primarily focused on understanding the flow of students to U.S. graduate education programs—PhD programs in particular—ignoring the largest group of international students in the United States: undergraduates. The greatest share of undergraduate international students enrolled at U.S. HEIs—about 35% in 2019/20—come from China (“International Students by Academic Level and Place of Origin”).¹ Furthermore, while the international trade literature has explored the flow of undergraduate students from China to the U.S. as a commodity (Khanna et al. 2020), these papers do not explore how improvements to China's higher education system may have impacted student flows. Through this work, the author seeks to understand how improvements to China's higher education system have affected the flow of Chinese students to U.S. HEIs.

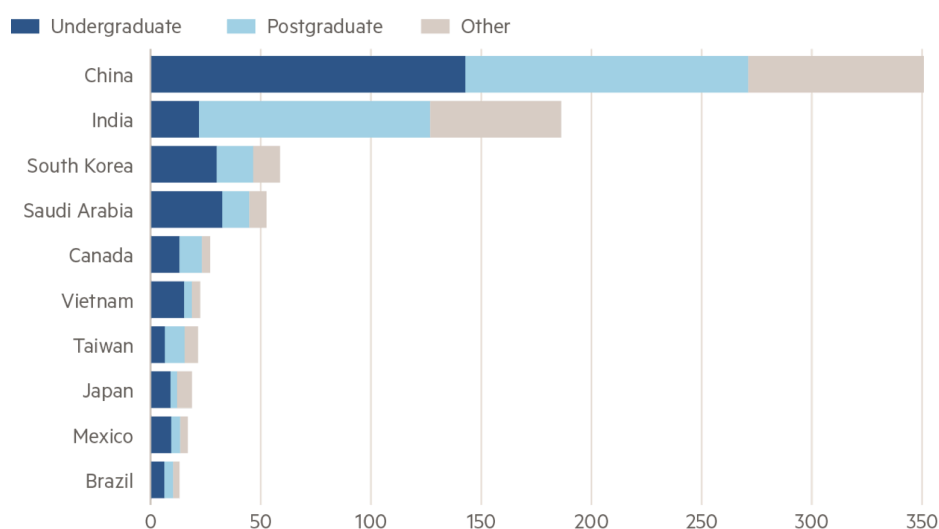
As some of the best higher education institutions in the world, U.S. HEIs have traditionally been able to attract top global talent to their programs. HEIs in the United States train some of the most academically prolific and successful individuals in the world (Maslak et al. 2005). In a 2020 ranking of HEIs by graduate employability, five of the top ten were located in the United States (“QS Graduate Employability Rankings 2020”). One study demonstrates a causal link between the number of foreign graduate students at U.S. HEIs and innovative activity, showing that an increase to the number foreign graduate students had a “significant and positive impact on both future patent applications and future patents awarded to university and non-university institutions” (Chellaraj 2008). An analysis of data from 1973-1998 found that international PhD students contribute significantly to the scientific productivity of science and engineering departments (Stuen et al. 2012). Data from “NAFSA: Association of International Educators” suggest that the 1.1 million international students in the U.S. contributed \$41 billion to the U.S. economy in the 2018-19 academic year (“New NASFA Data...”).

¹ Calculations performed by the author.

Less research, however, has looked at the specific contributions of undergraduate international students. Researchers have not yet been able to track the percent of Chinese undergraduates who stay and work in the U.S. economy, let alone the extent to which these individuals contribute to the U.S. economy. Previous work focuses on the absolute number of returnees per year, not per graduating cohort. The absolute number of “recently graduated” Chinese students who returned to China in 2020 was higher than ever before; 800,000 Chinese graduates from foreign HEIs returned to China—a 70% increase from 2019 (Huifeng 2020). This statistic can be misleading because we likely care more about the *percent* of Chinese students studying abroad who choose to return to China after graduation than the absolute number; the absolute number of returnees may increase year-over-year, but if the number of total Chinese enrollees at foreign HEIs increases at the same rate, then the percentage will stay constant. Furthermore, a 2017 graduate and a 2018 graduate would both be counted as returning to China in 2020, which further obfuscates the relevance of this statistic.

Figure 1: China is the biggest source of international students for the U.S.

International students by country of origin and academic level, 2016-17 ('000)



Source: Institute of International Education. Figure created by the Financial Times (Sevastopulo 2018).

The greatest share of international students at U.S. HEIs come from China, and this is particularly true of undergraduate students, as shown by the dark blue bars in Figure 1. Chinese students are also an important pool of talent based on their degree of academic success: A 2018 study conducted by the Organization of Economic Cooperation and Development (OECD) found that 15-year-old Chinese high-school students outperformed their peers in every other OECD member country in assessments of reading, math, and science (Schleicher 2019). However, the U.S. is

becoming increasingly hostile to Chinese students, potentially endangering this critical population of international students at U.S. HEIs.

Chinese PhDs in STEM fields intend to stay and work in the U.S. at very high rates, at least as recently as 2017. Researchers found that Chinese PhD intention-to-stay rates across seven broad STEM fields ranged from 75% to 95% (Zwetsloot et al. 2020). Unfortunately, researchers don't seem to have a robust, empirical method to estimate stay rates for Master's students and undergraduates.

Since 2018, the U.S. government has become increasingly hostile toward Chinese scholars and Chinese students in particular ("Information About the Department of Justice's China Initiative..."). In May 2020, President Trump signed an executive order intended to cancel U.S. visas for Chinese graduate students who are allegedly connected to China's defense-affiliated HEIs and thus deemed "high risk" by the U.S. Department of State (Wong and Barnes 2020, Feng 2020). U.S. government programs such as the Department of Justice's China Initiative have encouraged a culture of suspicion of foreign students and scholars, raising fears that the United States is no longer a safe place for Chinese nationals to study or work (Jing 2019). Unfortunately, we will likely be unable to measure the impact of recent hostility on the proportion of Chinese students who choose to stay and work in the U.S. after graduation until the data become available in a few years.

At the same time that the U.S. is becoming a more hostile place to study, China's top HEIs are competing with top U.S. HEIs in global rankings, and China is becoming an increasingly attractive place to grow one's career. The quality of China's higher education system has improved dramatically over the past two decades (Bradsher 2013, Nylander 2015). Chinese universities that were ranked between 201st and 300th in the 2016 Times Higher Education World University Rankings were all ranked higher than 125th by the 2021 ranking. Conversely, only about half of U.S. universities in the same band (201-300th) had improved their ranking at all by the 2021 ranking ("China continues to show its strength in global rankings"). Today, Chinese students have access to a far greater selection of high-quality domestic education options than they did twenty years ago.

In this paper, the author seeks to determine to what extent increases to the quantity of undergraduate education options in China influenced the quantity of Chinese undergraduate students enrolling at U.S. HEIs.

Research Question

To what extent have increases to the quantity of undergraduate education options in China influenced the quantity of Chinese undergraduate students enrolling at U.S. HEIs?

Some research supports the hypothesis that Chinese enrollment in U.S. HEIs declined due to the rapid influx of students to China's own HEIs. The post-1999 Chinese enrollment boom is correlated with a decreasing growth rate in the number of Chinese students studying abroad (Li 2010). However, the post-1999 enrollment boom in Chinese HEIs is one among many potential drivers of Chinese enrollment in U.S. HEIs. A series of economic trends and policies have put new pressures on Chinese enrollment at Chinese HEIs as well as on Chinese enrollment at U.S. HEIs.

Chinese Enrollment at HEIs in China and the U.S.

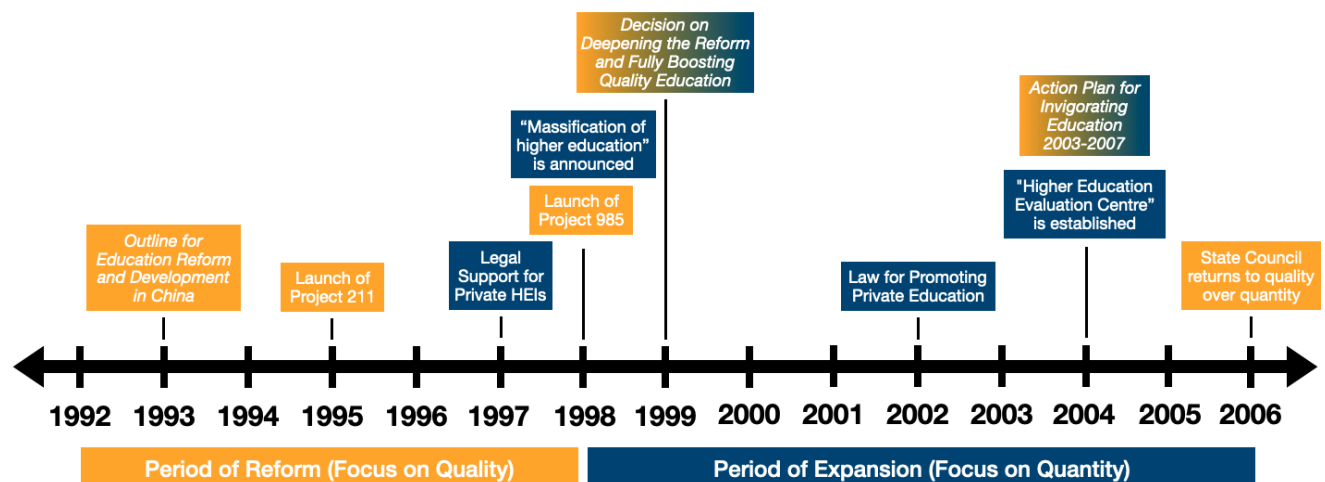
An enrollment boom in China's domestic HEIs began in 1999 and continued through the mid-2000s. This enrollment boom followed a series of education transformation policies pursued by the Chinese government (Li 2012). Between 1992 and 2021, two significant new sets of policies occurred, one in China and one in the United States. First, a series of central government education policies sought to improve the quantity of Chinese undergraduate students enrolled at Chinese HEIs. Second, the U.S. undertook a series of new immigration policies, some of which increased constraints on foreign students and some of which loosened constraints. Both sets of policies are discussed in the following sections.

Chinese Domestic Education Policies

The author's analysis of Chinese education policies sought to understand how Chinese higher education evolved from the early-1990s through the mid-2000s (Figure 2). From 1992 to 1998, the Chinese central government primarily implemented education reform policies that sought to improve the quality of Chinese higher education. Then, the Chinese government shifted from improving quality to increasing quantity. From 1998 to 2006, the government focused on expanding the scale of higher education in China. In May 2006, the State Council of the People's Republic of China announced that it wanted to refocus on improving the quality of higher education instead of continuing to expand the scale of Chinese HEIs (Cai 2013).

The Chinese government launched two key projects that sought to improve the education quality of domestic HEIs. First, in 1995, the Chinese government launched “Project 211,” which provided funding to about 100 HEIs to improve “teaching, research and administration” in key disciplinary areas (Cai 2013). Then, in 1998, the Chinese government launched “Project 985,” which sought to develop world-class universities by allocating special development funds—from the central government as well as provincial governments—to a small set of high-performing universities (Cai 2013). When it was launched, Project 985 only funded two universities: Tsinghua University (清华大学) and Peking University (北京大学). To date, only 39 universities have received Project 985 status (“Project 211 and 985”).

Figure 2: Timeline of Central Chinese Education Policies



Even when the Chinese government claimed to be focusing on improving the quality of higher education (1992-1998), the government still laid the groundwork for the subsequent period of expansion. In 1997, the PRC State Council enacted a policy titled “Regulations on the Social Forces Running Educational Establishments,” which solidified the legality for private governance of an HEI in China. Private education in China received final legal approval in 2002 when the Standing Committee of the National People’s Congress passed the “Law for Promoting Private Education” (Cai 2013).

In 1998, the Chinese government announced that it would seek to transform Chinese higher education from an elite system to a “massified” system (Cai 2013). The policy was announced in the aftermath of the Asian Financial Crisis as the Chinese government sought to stimulate economic growth by encouraging domestic demand in sectors such as higher education (Li 2001). To accomplish this goal, the Chinese government sought to rapidly expand enrollment at Chinese HEIs.

In addition to explicit education policies, the Chinese government's public messaging may also put downward pressure on the number of Chinese students enrolling at U.S. HEIs. On June 3, 2019, China's Ministry of Education issued the following warning to Chinese students studying in the United States:

"The visa review period has been extended, the validity period has been shortened and the refusal rate has increased. This has affected the Chinese students studying in the United States normally or successfully completing their studies in the United States. The Ministry of Education reminds students and scholars to strengthen risk assessment before going abroad to study, enhance awareness of prevention and make appropriate preparations." (Redden 2019)

The next day, China's Ministry of Foreign Affairs (MOFA) and Ministry of Culture and Tourism also issued warnings for Chinese nationals in the United States. MOFA's statement warned that: "recently, U.S. law enforcement agencies have on multiple occasions used methods such as entry and exit checks, and on-site interviews to harass Chinese citizens in the U.S." (Cheng 2019) These warnings may discourage Chinese students from applying to undergraduate programs in the United States.

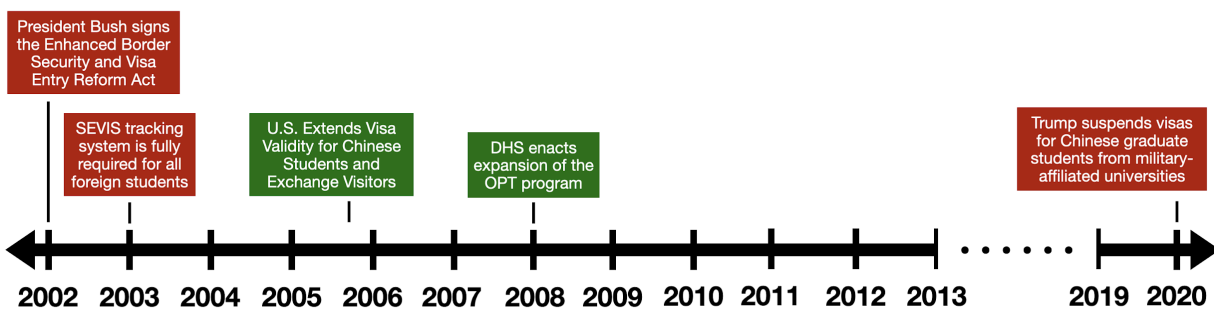
U.S. Immigration Policies

An analysis of U.S. immigration policy identified two key policies that may have exerted upward pressure on the number of Chinese undergraduate enrollees at U.S. HEIs (Figure 3, green boxes). In June 2005, The U.S. Department of State extended the duration of F-1 visas for Chinese students from 6 months to 12 months ("U.S. Extends Visa Validity..."), and in 2008, the U.S. Department of Homeland Security expanded its Optional Practical Training (OPT) program, which provides visa extensions for international students who wish to gain work experience in the U.S.

In Yingyi Ma's book "Ambitious and Anxious," she argues that the rapid acceleration of Chinese undergraduates enrolling at U.S. HEIs (beginning in 2008) was a combination of three key factors (Ma 2020):

- The previously mentioned 2005 State Department policy extended visa validity for Chinese students ("U.S. Extends Visa Validity..."),
- The RMB appreciated relative to the dollar, which helped make tuition at U.S. HEIs more affordable to Chinese households,
- Chinese household incomes rose, which also helped make tuition at U.S. HEIs more affordable to Chinese households.

Figure 3: Timeline of U.S. Immigration Policies



Ma identifies two additional factors that one needs to control for in a causal analysis: the appreciation of the RMB and rising incomes of Chinese households. Ma's analysis supports the argument that the expansion of Chinese higher education options and changes to U.S. immigration policy do not solely explain changes to the quantity of Chinese students enrolled at U.S. HEIs.

Other U.S. immigration policies may have exerted downward pressure on the number of Chinese undergraduate enrollees at U.S. HEIs (Figure 3, red boxes). In 1996, President Clinton signed the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA), which required the U.S. government to begin developing an electronic system to track foreign students' enrollment and visa status ("Illegal Immigration Reform and Immigrant Responsibility Act of 1996"). This system is known as the Student and Exchange Visitor Information System (SEVIS). In 2002, President Bush signed the Enhanced Border Security and Visa Reform Act, which required that SEVIS become more detailed and expansive to support additional data collection and notification requirements (Camarota and Jenks 2003). The updated version of SEVIS was fully implemented by January 30, 2003. The increased level of scrutiny under SEVIS may have dissuaded some Chinese students from coming to study in the U.S.

From 2017-2021, the Trump administration implemented a number of policies that signaled the administration's intention to prosecute Chinese intellectual property thieves and reduce technology transfer from U.S. companies to the China's military. On June 11, 2018, the administration shortened the length of graduate student visas in certain STEM fields (e.g. aviation and robotics) from five years to one year (Redden 2018). Then, in May 2020, the Trump administration announced that the State Department would no longer grant visas to Chinese graduate students who had attended Chinese defense-affiliated HEIs (Wong and Barnes 2020, Feng 2020). Policies such as

these—even though they don't directly target Chinese undergraduate students—have still exacerbated the feeling among Chinese undergraduates that they are increasingly unwelcome in the United States (Fish 2018, Fischer 2021, Yu et al. 2020).

COVID-19 has likely further damaged the attractiveness of U.S. HEIs to Chinese students. In spring 2020, even before the pandemic had begun to truly devastate the United States, an Amherst College study found that 87% of surveyed school-based college counselors in China said that Chinese students and parents were “reconsidering their plans for studying in the United States and diversifying their options of college destinations” (Wan 2020). In the same study, 78% of the surveyed counselors identified safety as a key concern for Chinese parents. As the Trump administration imposed visa restrictions to reduce the spread of COVID-19 through international travel, domestic Chinese HEIs became more attractive to Chinese students, at least for graduate school applicants (Moules 2020).

Even as the short-term foreign enrollment shock caused by national lockdowns comes to an end, concerns remain about the long-term impact of COVID-19 on Chinese enrollment at U.S. HEIs. As of March 2021, one year after COVID-19 lockdowns began in the United States, the U.S. leads the world with over 530,000 deaths, compared to an official count of just 4,700 in China. At the very least, the large number of COVID-19 deaths in the U.S. may harm Chinese students' perceptions of the safety of U.S. schools over the next few years. In addition, Chinese students might perceive COVID-19 policies in many U.S. states as insufficiently restrictive, increasing their hesitancy to enroll at a U.S. HEI in those locations. Furthermore, persistent uncertainty about the visa status of international students may continue to depress Chinese enrollment rates at U.S. HEIs.

Social and Economic Trends

Chinese students increasingly hope to study at schools in the U.K. and Canada.

A survey of Chinese students published in July 2020 by the New Oriental Education & Technology Group found 42% of students hoped to study in the U.K., while only 37% hoped to study in the U.S. A previous study by the same group in 2016 found that 30% of respondents hoped to study in the U.K. and 46% hoped to study in the U.S (Yan 2020). This change indicates that Chinese students may increasingly prefer to study at foreign HEIs that are not located in the U.S.

Chinese students may also hesitate to enroll in a U.S. HEI because employers back home favor graduates from Chinese HEIs over those from U.S. HEIs. One 2020 study found that U.S.-educated applicants for computer science and business jobs were, on average, 18% less likely to receive a callback interview compared with applicants who

attended a Chinese HEI (Chen 2019). Even applicants from highly selective U.S. HEIs underperformed applicants who graduated from the least selective Chinese HEIs.

Rising Chinese household incomes

Rising household incomes may have made tuition at U.S. HEIs more affordable for many Chinese families. Recent research suggests that the wealthiest Chinese households experienced income growth, which helped a greater proportion of Chinese families afford tuition at a U.S. HEI (Khanna et al. 2020).


Appreciation of the RMB

China's currency, the Renminbi (人民币, RMB), notably appreciated by about 37% from 2006 to 2014 after the Chinese government modified its "currency valuation policies" in mid-2005 (Ma 2020). This appreciation of the RMB augmented the buying power of Chinese households, increasing (for many families) the affordability of tuition at a U.S. HEI.

Summary of factors that may influence how many Chinese students pursue their undergraduate education in the U.S. or China

The factors that may influence whether Chinese students pursue their undergraduate education in the U.S. or China can be categorized by the type of effect. First, a variety of factors could impact Chinese undergraduate students' access to Chinese HEIs. These factors include the ease of admission to a Chinese HEI and the affordability of tuition at a Chinese HEI (Table 1).


Table 1: Factors that could impact Chinese student's access to Chinese HEIs.



PRC allows and supports private HEIs	Creation and expansion of additional private HEIs
Changes to the 高考?	It's easier/more challenging to get into a Chinese HEI
Growing Chinese middle class	More Chinese families have the finances to enroll their children in Chinese HEIs.

Second, a variety of factors could impact Chinese undergraduate enrollment at Chinese HEIs. These factors include an increase in government funding for top schools or government direction for “massification of education” (Table 2).


Table 2: Factors that could impact Chinese enrollment at Chinese HEIs.



Increase in PRC funding of top HEIs (Projects 985 and 211) coupled with reduction in corruption	Chinese HEIs are able to support more students
PRC direction for "massification of higher education" (1998)	Chinese universities are able to support more students and more universities are created
Growing necessity of a college degree to build a life for yourself	More Chinese students want to enroll in HEIs
Culture that increasingly emphasizes the importance of educational attainment	

Third, a variety of factors could impact Chinese undergraduate students' access to U.S. HEIs. These factors include changes to U.S. immigration policy, rising Chinese household incomes, and enrollment constraints at land-grant public universities (Table 3).

Table 3: Factors that could impact Chinese student's access to U.S. HEIs.




Changes to U.S. Immigration policy (restrictions in May 2002, loosening in June 2005)	U.S. government tightens/loosens restrictions that permit Chinese undergraduates to study in the U.S.
President Bush signs the Enhanced Border Security and Visa Entry Reform Act in May 2002 — restricting visas	
U.S. Extends Visa Validity for Chinese Students and Exchange Visitors in June 2005	
Growing Chinese middle class	More Chinese families have the finances to enroll their children in U.S. universities.
Enrollment constraints on percentage of out-of-state students at land-grant universities	Land-grant universities are forced to cap number of Chinese students as more start applying to U.S. HEIs.

Purple text indicates a rationale for the 2006/07 rise in enrollment provided by Yingyi Ma in *Ambitious and Anxious*

Fourth, a variety of factors could impact Chinese undergraduate enrollment at U.S. HEIs. These factors include changes Chinese students' interest in studying abroad, changing preferences for study abroad countries, and changing demand by U.S. HEIs for international students (Table 4).

Table 4: Factors that could impact Chinese enrollment at U.S. HEIs.



U.S. HEIs need tuition from Chinese undergrads after 2008 financial crisis	Increased demand by U.S. HEIs for Chinese or all international students
Increase in total Chinese undergrads	Proportionate increase in number of Chinese students applying to/enrolled at U.S. HEIs
Chinese HEIs become more/less globally competitive in specific fields	Chinese students become more/less interested in studying abroad
Changing job opportunities in China (<i>not totally convinced</i>)	
Changing nationalist views of Chinese students	
Chinese government encourages/discourages Chinese students from studying abroad	
Increase in incomes of Chinese households	Chinese students become more/less financially able to studying abroad
Chinese government allowed the RMB to appreciate between 2006-2014	
U.S. HEIs improve recruitment tactics/incentives to attract Chinese undergrads	Chinese students who want to study abroad increasingly/decreasingly prefer U.S. HEIs over those in other countries (e.g. U.K., Canada, E.U., Australia)
Non-U.S. HEIs improve recruitment tactics/incentives to attract Chinese undergrads	
Chinese government encourages/discourages Chinese students from studying at U.S. HEIs	

Purple text indicates a rationale for the 2006/07 rise in enrollment provided by Yingyi Ma in *Ambitious and Anxious*

The author hypothesizes that U.S. immigration and the increased affordability of U.S. HEIs for Chinese families (due to rising incomes and the appreciation of the RMB) are likely the two most important factors driving changes to Chinese undergraduate enrollment at U.S. HEIs.

These are some among many potential forces that could be exerting upward or downward pressure on Chinese enrollment at U.S. HEIs. In this paper, the author lays a correlational foundation for assessing the extent to which increases to the quantity of undergraduate education options in China influenced the quantity of Chinese undergraduate students enrolling at U.S. HEIs. Since this research question would necessitate a wide-ranging series of analyses, this paper shaves off a narrow slice for closer study. Specifically, this paper shows how the proportion of Chinese undergraduates enrolled in U.S. HEIs versus Chinese HEIs, disaggregated by field, has changed over time.

Methods

This novel analysis joins datasets that report the number of Chinese undergraduate students enrolled at U.S. HEIs with a dataset that reports the number of undergraduate students enrolled at Chinese HEIs.

The number of Chinese undergraduate students enrolled at U.S. HEIs is collected from two sources: the Institute for International Education’s (IIE) annual *Open Doors* report (“Open Doors”) and summary tables from the U.S. Department of Homeland Security’s Student and Exchange Visitor Information System (SEVIS).² The IIE data are available from 1998 until 2018, however these data unfortunately do not jointly disaggregate by country of origin and field of study. The SEVIS data jointly disaggregate by country of origin and field of study, but these data are only available from 2006 until 2018.³ See Table 5 (columns three and four) for additional details.

Table 5: This study uses data from SEVIS, IIE, and China’s Ministry of Education.

Source	Chinese Ministry of Education	SEVIS (DHS)	IIE
Enrollment vs. Degree Completion	Enrollment	Enrollment	Enrollment
Field of Study (CIP)	Chinese Equiv. of CIP-2	CIP-2	N/A
Degree Levels	Undergrad	Undergrad/Grad (Masters/PhD for 2017-2018)	Undergrad/Grad
Date	1997-2018	2006-2018 (excl. 2015)	1998-2019

The number of Chinese undergraduate students enrolled at Chinese HEIs was collected from the Chinese Ministry of Education’s (MOE) public website. The MOE has published the number of enrollees disaggregated by field of study from 1997 until 2018.

Next, these three datasets were joined together at the most granular level possible. The data from China’s MOE were joined with the SEVIS data such that each observation reported the number of Chinese enrollees at U.S. HEIs and Chinese HEIs for a given

² These summary tables are included in the appendices of the Science and Engineering Indicators reports, which are published by the National Center for Science and Engineering Statistics: <https://nces.nsf.gov/indicators>

³ The Science and Engineering Indicators report also did not publish SEVIS data from 2015.

year and field of study. In order to join these data by field, it was necessary to translate fields of study that were originally reported in Mandarin Chinese by China's MOE and match them with fields of study recorded in SEVIS. The IIE data could only be joined with China's MOE data at the annual level; it was not possible to retain field-specific data for this combination of datasets due to the limitations of the IIE data.

Equation 1

Number of Chinese Undergrads at US HEIs

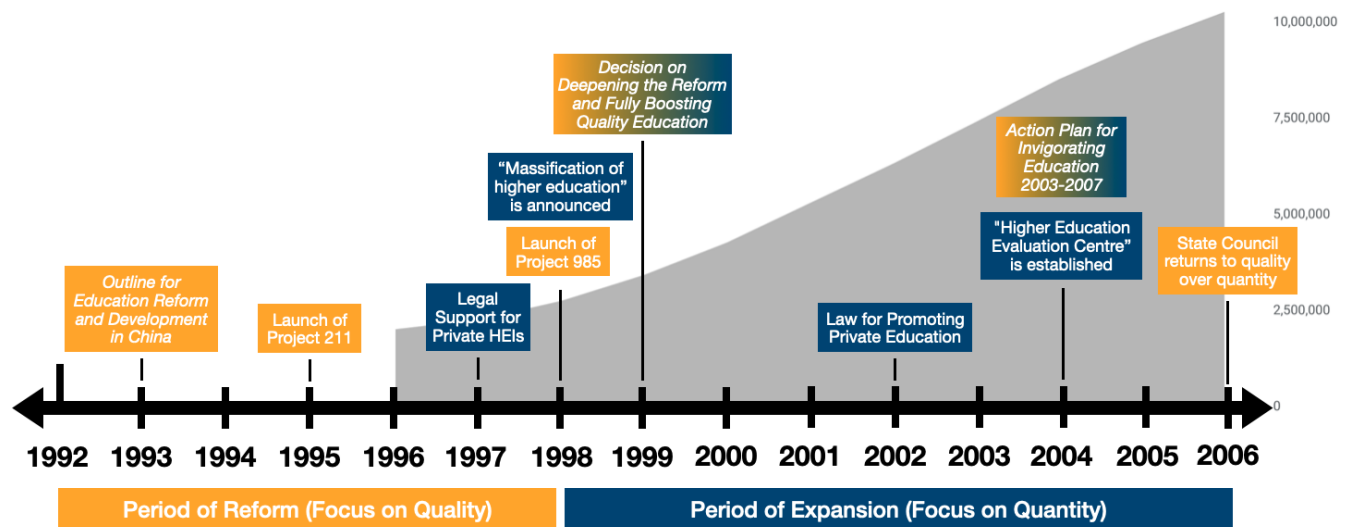
$$(Number\ of\ Chinese\ Undergrads\ at\ US\ HEIs) \div (Number\ of\ Chinese\ Undergrads\ at\ US\ HEIs) + (Number\ of\ Chinese\ Undergrads\ at\ Chinese\ HEIs)$$

Then, once these datasets were joined, the author calculated the percentage of total Chinese undergraduates enrolled at U.S. HEIs (see Equation 1) by year and field of study. This indicator can help us understand how successfully, on aggregate, the U.S. and China are competing with one another to train Chinese undergraduate students.

Results

Undergraduate enrollment at Chinese HEIs expanded from about 3 million students in 1998—the year when the Chinese government began to focus on expanding domestic HEI enrollment—to over 10 million by 2006. Figure 4 shows how Chinese higher education reform policies overlap with growth in enrollment at Chinese HEIs.

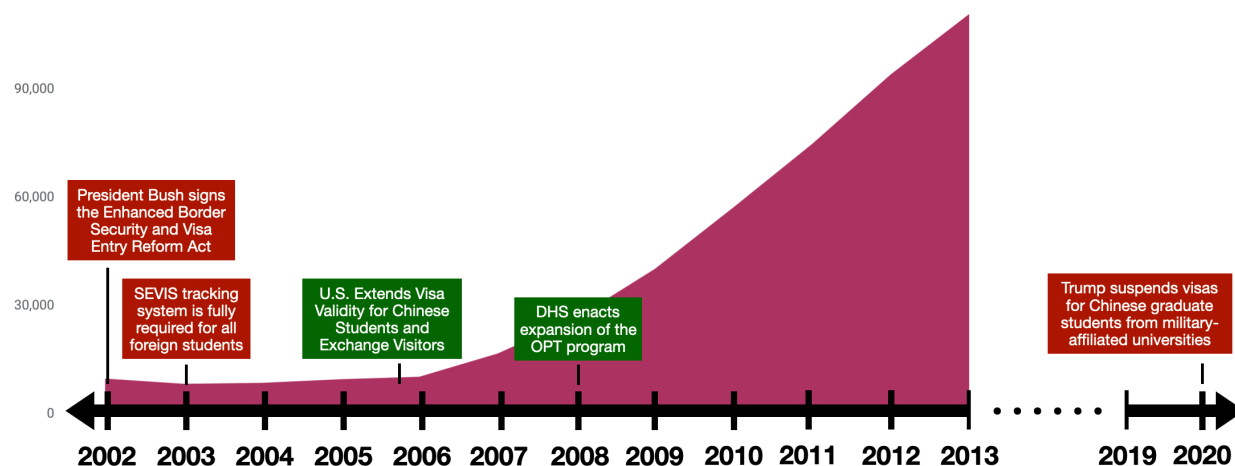
Figure 4: Timeline of central Chinese education policies overlayed on the number of undergraduate enrollees at Chinese HEIs per year



Source: Timeline was created by the author from a variety of sources. The graph of undergrad enrollees at Chinese HEIs was created from data reported by China's Ministry of Education.

Chinese undergraduate enrollment at U.S. HEIs expanded from about 9,500 in 2002 to 110,000 by 2013. Figure 5 superimposes relevant U.S. immigration policy changes on a graph of the number of undergraduate Chinese enrollees at U.S. HEIs per year. This figure identifies the June 2005 U.S. visa extension for Chinese students as a potentially interesting policy shock since it occurred just before the rise in undergraduate Chinese enrollment at U.S. HEIs began in 2007.

Figure 5: Timeline of U.S. immigration policies overlayed on the number of undergraduate Chinese enrollees at U.S. HEIs per year



Source: Timeline was created by the author from a variety of sources. The graph of undergrad enrollees at U.S. HEIs was created from data reported by the International Institute of Education (IIE).

Figure 6 shows side-by-side the total number of Chinese undergraduate enrollments per year at Chinese HEIs (on the left) and U.S. HEIs (on the right). Notably, while enrollment at Chinese HEIs rises from less 2.5 million in 1996 to about 10 million in 2006, the number of Chinese enrollees at U.S. HEIs held steady at about 6,000 students until 2007. In recent years, the growth rate of enrollment at Chinese HEIs has decreased slightly. The growth rate of Chinese enrollment at U.S. HEIs slowed between 2012 and 2017 (Table 6). From 2017 to 2018, the number of Chinese enrollees did not seem to increase at all

Combining the two plots in Figure 7, we can visualize the fraction of total Chinese undergraduates (U.S. and Chinese HEIs combined) that are enrolled at U.S. HEIs (Equation 1). When fields are aggregated (Figure 7), we see that the fraction initially declines from 0.25% in 1997 to about 0.12% in 2006. As we saw in Figures 4-6, Chinese enrollment at U.S. HEIs stagnated during this period, while enrollment at Chinese HEIs expanded. Then, reaching an inflection point in 2006, the fraction began to increase, ultimately peaking at about 0.83% in 2017 (still using IIE data) before declining slightly in 2018.

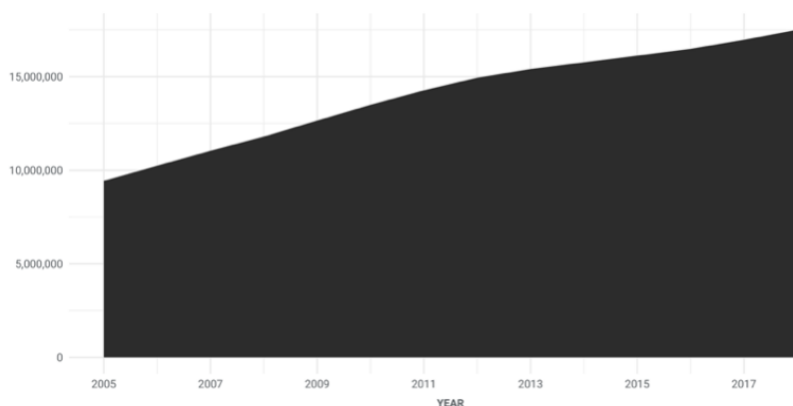
Table 6: Growth rate of Chinese undergraduate enrollment at Chinese HEIs versus U.S. HEIs, 2012-2018

Year	Growth rate of Chinese undergraduate students at...	
	Chinese HEIs	U.S. HEIs
2012	4.7%	25.9%
2013	3.1%	17.9%
2014	2.3%	12.7%
2015	2.3%	8.9%
2016	2.2%	5.3%
2017	3.0%	4.0%
2018	3.2%	0.2%

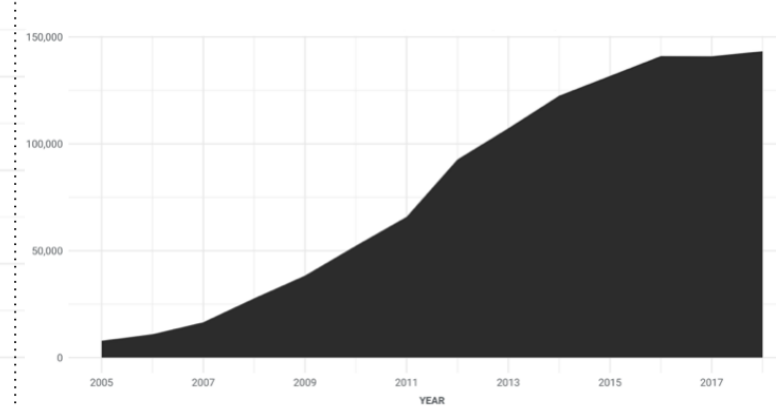
Source: Data in column two come from China's Ministry of Education. Data in column three come from the IIE.

Figure 6: Number of Chinese undergraduate students enrolled at Chinese HEIs per year vs. U.S. HEIs, 2005-2018

Chinese Students at **Chinese HEIs**

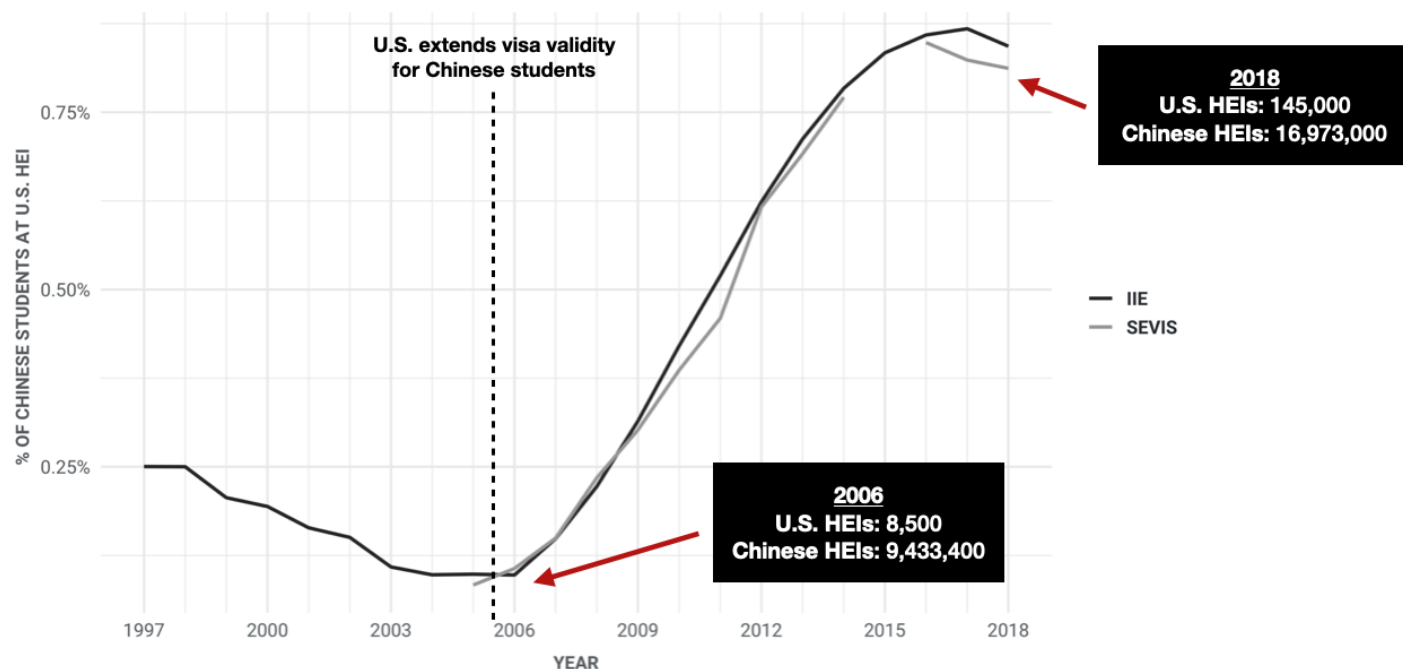


Chinese Students at **U.S. HEIs**



Source: China's Ministry of Education (left) and SEVIS (right)

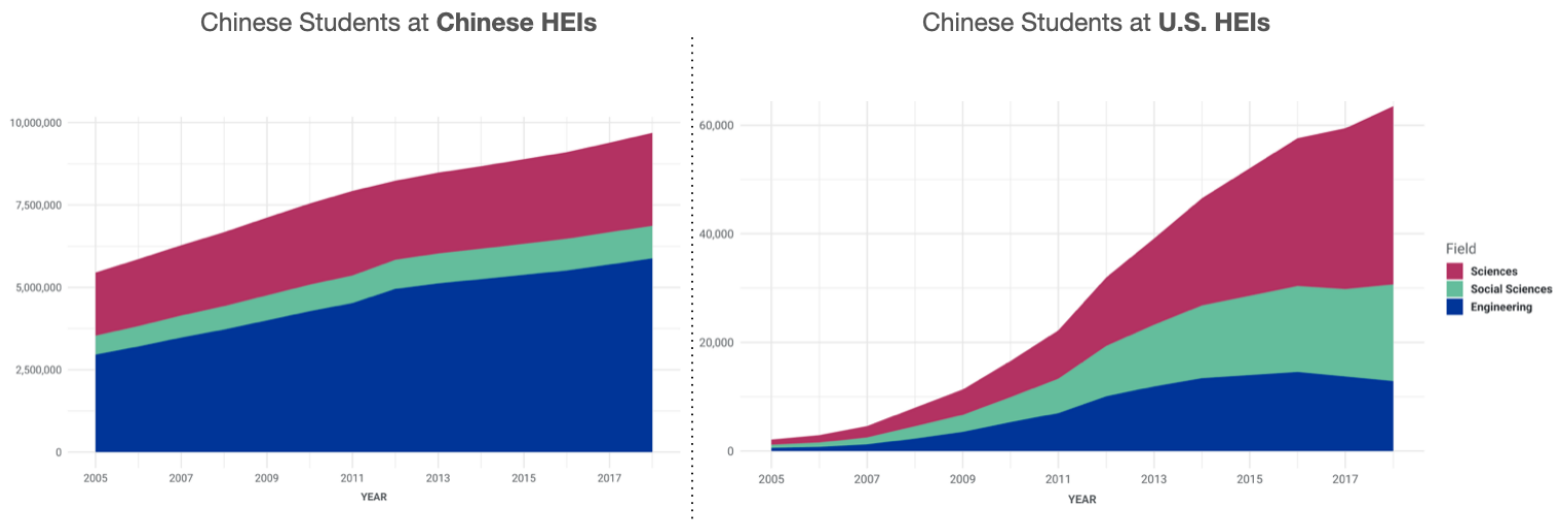
Figure 7: Chinese students at U.S. HEIs as percentage of total Chinese enrollment over time, 1997-2018



Source: China's Ministry of Education, SEVIS, and IIE

Next, we disaggregate the data to determine if any diverging trends emerge between fields of study. We begin by focusing on three categories of fields—social sciences, hard sciences, and engineering—and we filter out all other fields. Figure 8 provides a side-by-side comparison of enrollment growth in each of these three fields, at Chinese HEIs (on the left) and U.S. HEIs (on the right) from 2005 to 2018. At Chinese HEIs, enrollment in the hard sciences and social sciences remained relatively constant over the time period. Chinese HEI enrollment in engineering expanded more substantially from 2.96 million in 2005 to 5.88 million in 2018. At U.S. HEIs, enrollment in all three fields grew substantially over the time period. In 2018, hard sciences had the largest enrollment of the three fields, roughly the same size as social sciences and engineering added together.

Figure 8: Number of Chinese undergraduate students enrolled at Chinese HEIs per year vs. U.S. HEIs for select fields (science, social sciences, and engineering), 2005-2018

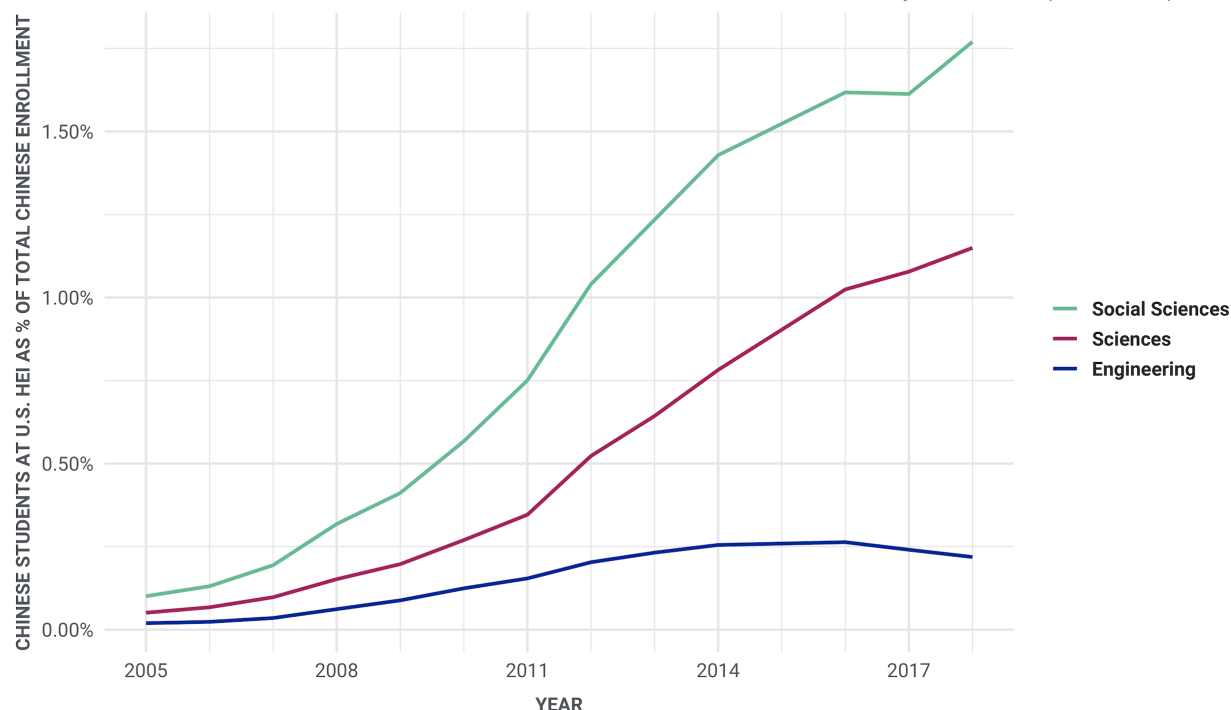


Source: China's Ministry of Education (left) and SEVIS (right)

Combining the two plots in Figure 9, we can visualize the fraction of total Chinese undergraduates that are enrolled at U.S. HEIs for each of these three fields. While the fractions for social sciences, hard sciences, and engineering students were all close to zero in 2005, they have since diverged from each other. The fraction of social sciences students increased more quickly than the other two fields, rising to about 0.75% by 2011, by which point the other two fields were still both below 0.25%. Since then, the fraction of social sciences continued to climb to just above 1.75% by 2018.

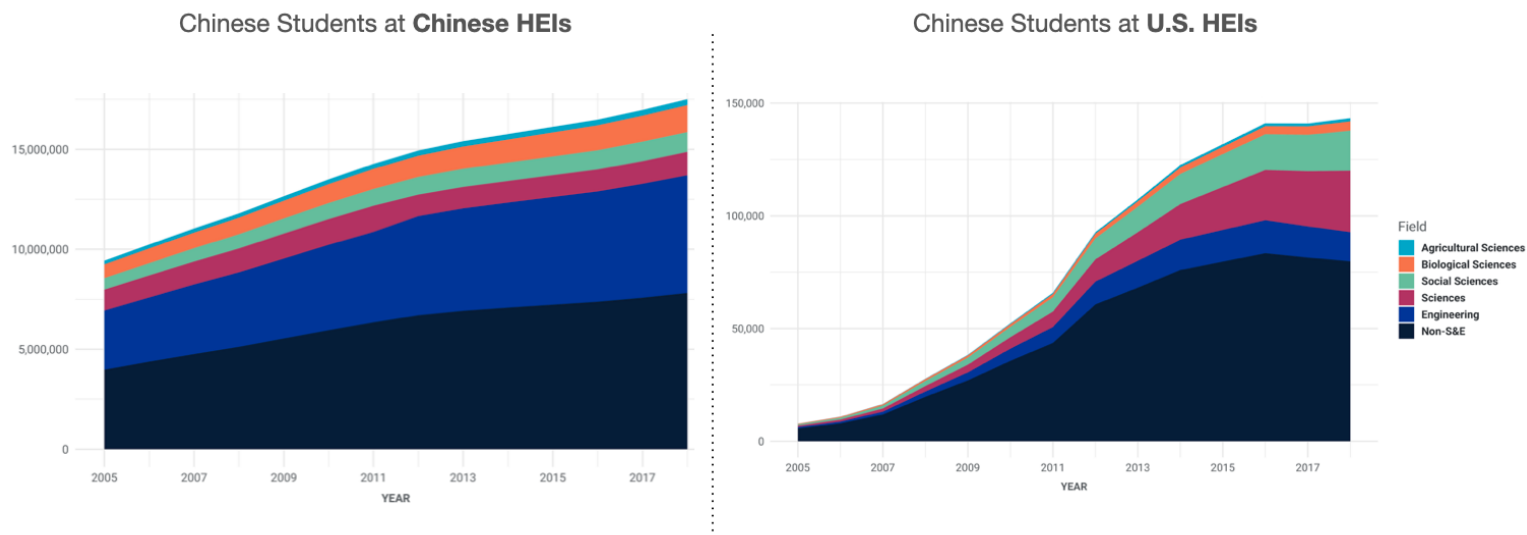
Approximately 18,000 Chinese social science students were enrolled at U.S. HEIs in 2018. From 2011 to 2018, sciences and engineering began to diverge from each other. The fraction of students studying hard sciences continued to climb, reaching 1.15% in 2018, while the fraction of students studying engineering reached a peak of about 0.25% in 2016 before falling slightly in 2018. Approximately 33,000 Chinese hard science students and 13,000 Chinese engineering students were enrolled at U.S. HEIs in 2018. These diverging trends indicate that undergraduate talent flows between the U.S. and Chinese may indeed vary between fields.

Figure 9: Chinese students at U.S. HEIs as percentage of total Chinese enrollment over time by select fields (science, social sciences, and engineering), 2005-2018



Source: China's Ministry of Education and SEVIS

Figure 10: Number of Chinese undergraduate students enrolled at Chinese HEIs vs. U.S. HEIs by field, 2005-2018

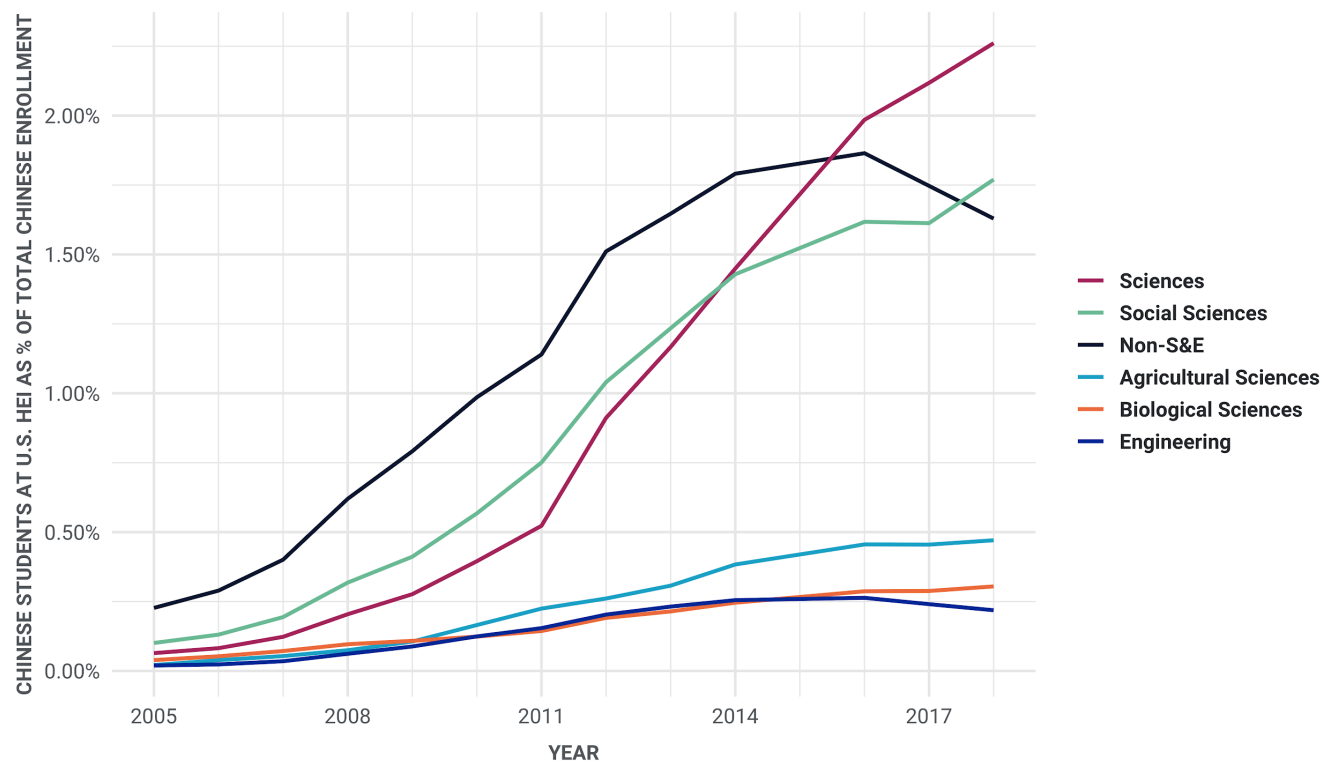


Source: China's Ministry of Education (left) and SEVIS (right)

Zooming out to all tracked fields, Figure 10 shows side-by-side the number of Chinese undergraduate enrollments at Chinese HEIs (on the left) and U.S. HEIs (on the right) per year and field of study. In Figure 10 and Figure 11, the author disaggregates hard sciences into agricultural sciences, biological sciences, and all other hard sciences (labeled “sciences”).

When we look at all fields captured by the data, two divergent trends emerge (Figure 11). The proportion of Chinese students enrolled at U.S. HEIs in social sciences, non-S&E, and other hard sciences (“sciences”) grew relatively quickly over time to over 1.5% by 2018. Agricultural sciences, biological sciences, and engineering, however, grew much more slowly over time, and had not even exceeded 0.5% by 2018.

Figure 11: Chinese students at U.S. HEIs as percentage of total Chinese enrollment over time by field, 2005-2018



Source: China's Ministry of Education and SEVIS

Discussion

Two main stories emerge from these results. First, the descriptive data suggest that the accessibility of U.S. higher education is likely a more important driver of changes to Chinese student enrollment in U.S. HEIs compared with changes to China's own education system. Second, while the percentage of Chinese undergraduate students studying the social sciences and hard sciences choosing to attend U.S. HEIs has been increasing over the past years, the percentage of Chinese undergraduates studying engineering at U.S. HEIs has been, in recent years, constant or even declining.

If changes to China's own education system were driving changes to Chinese student enrollment in U.S. HEIs, we would expect to see two similarly shaped plots in Figure 6 as well as a relatively linear Figure 7. Instead, in Figure 6 the growth in domestic Chinese undergraduate enrollment from 2005 to 2018 has a very different shape from enrollment growth of Chinese undergraduates at U.S. HEIs, and the variation over time in Figure 7 tells a similar story. These plots suggest that existing demand by Chinese students for a U.S. undergraduate education is higher than supply, and increased accessibility at the margin should increase Chinese undergraduate enrollment. Accessibility, as the author defines it here, has two main components: visa restrictiveness and the affordability of tuition.

When visa policies are restricted, some Chinese students may choose not to apply to U.S. programs while others may still apply but receive a rejection on their visa application. A visa policy loosening occurred in June 2005 ("U.S. Extends Visa Validity..."), not long before the surge of Chinese enrollees at U.S. HEIs began in August 2007. If this (or another) policy had a causal impact on the number of Chinese students enrolling at U.S. HEIs, it makes sense that enrollment increase would begin a few years later, since the very first class of students that could theoretically respond to the policy would only enter HEIs in fall 2006. However, since the policy merely increased the length of student visas from six months to one year, it is unclear whether the policy offered sufficient regulatory relief to incentivize additional Chinese students to enroll at U.S. HEIs.

While it might seem natural to solely attribute changes in Chinese students' access to U.S. higher education to a combination of social factors and changes in the U.S. visa system, it would be a mistake to ignore the affordability of tuition. Since most U.S. HEIs charge international undergraduates full tuition, the affordability of tuition is a barrier for many Chinese students who wish to attend a U.S. HEI. As previously discussed, American undergraduate education became more affordable to Chinese families as average household income rose throughout the 2000s, and tuition affordability was

further augmented when the RMB appreciated between 2005 and 2008 (Bound et al. 2020). The increased affordability of U.S. HEIs to Chinese students may have influenced the surge in Chinese enrollees at U.S. HEIs that began in 2007.

The descriptive data also show that, in recent years, the percentage of Chinese undergraduate engineers studying at U.S. HEIs is declining while the percentage of Chinese undergraduate hard science and social science students studying at U.S. HEIs is increasing (Figure 11). That the percentage of undergraduate Chinese hard science and social science students enrolled at U.S. HEIs continues to increase suggests that, in these fields, Chinese student demand for undergraduate programs at U.S. HEIs still exceeds supply. Conversely, that the percentage of Chinese undergraduate engineers studying at U.S. HEIs has stagnated or even declined suggests that Chinese student demand for undergraduate engineering programs at U.S. HEIs no longer exceeded supply by 2018.

For a fixed cost of tuition, the percentage of Chinese undergraduates studying in the U.S. might vary for many reasons. One reason is field-specific discrepancies with respect to job market access and salaries in China. A 2013 survey finds that for Chinese students who pursued arts and humanities in high school, those who immediately entered the job market actually received, on average, a higher starting salary than their peers who pursued higher education in China before entering the job market (Stapleton 2017). Meanwhile, college graduates in engineering, economics, and the hard sciences experience high starting salaries and low unemployment rates in the Chinese job market (Stapleton 2017). There also may be field-specific differences in perceptions regarding the quality of education and opportunity sets offered through a degree in the U.S. versus China. For example, the quality of Chinese undergraduate engineering programs might be more comparable to that of U.S. undergraduate engineering programs than the quality of Chinese undergraduate humanities programs is to that of U.S. undergraduate humanities programs.

The observed differences in Chinese undergraduate enrollment patterns by field could also be representative of other selection biases. For example, Chinese high schoolers' chosen field of study could be correlated with their proclivity to study abroad. For example, Chinese students who are drawn towards the humanities may be disproportionately drawn towards the relatively more open academic environment in the United States. In addition, the wealth of a Chinese family might be positively correlated with both (1) the family's ability to pay the tuition of the U.S. HEI, and (2) the extent to which the parents will support a child who wishes to pursue a social science degree. In other words, wealthier parents, who are disproportionately able to pay the tuition of U.S. HEIs, may also be disproportionately likely to encourage their children to pursue a

degree with a lower average starting salary (e.g. social sciences). In addition, although U.S. visa regulations do not explicitly cap the total number of Chinese students who are permitted to study in the United States, the supply of U.S. undergraduate education to Chinese students is constrained by the rate at which U.S. HEIs accept Chinese students. U.S. HEIs may admit Chinese students at disproportionately high rates in some fields over others.

U.S. policymakers who focus on talent competitiveness issues should adopt a field-specific approach. When we look across all fields captured in Figure 11, for some, namely social sciences and other hard sciences, the proportion of Chinese students at U.S. HEIs continues to increase. For others, namely engineering and non-S&E, the proportion of Chinese students at U.S. HEIs has already peaked and now declines. If policymakers aim to ensure that an increasing share of Chinese STEM students are trained in the United States, then policies should focus on STEM fields where the share of Chinese students at U.S. HEIs has peaked: engineering and biological sciences, but not other hard sciences such as mathematics, physics, and chemistry.

Considering that the Chinese government has mobilized billions of dollars to improve the competitiveness of Chinese HEIs, it is actually quite impressive that U.S. HEIs are enrolling a constant share of Chinese students in engineering fields. That the share of Chinese engineering undergraduates enrolled at U.S. HEIs is constant and perhaps only declining slightly is a testament to the continued excellence and competitiveness of U.S. HEIs' undergraduate engineering programs. However, factors such as increasing discrimination and suspicion of Chinese nationals is likely exerting downward pressure on Chinese student enrollment at U.S. HEIs—potentially decreasing the share of Chinese students in each field who enroll at U.S. HEIs. Policymakers should take action to increase the attractiveness of U.S. universities to foreign students.

U.S. policymakers seeking to ensure that U.S. HEIs remain competitive for top talent in STEM fields should focus on barriers that international students face as they attempt to enroll at U.S. HEIs. This study suggests that, in the past, increasing tuition affordability has increased U.S. HEIs' competitiveness for Chinese undergraduate students. Policies that continue to increase tuition affordability may further increase U.S. HEIs' competitiveness for Chinese undergraduate students. To the extent that racial discrimination as well as U.S. government programs such as the Department of Justice's China Initiative are discouraging Chinese students from studying at U.S. HEIs, policymakers should seek to ensure that Chinese students feel welcome and supported. In addition, if local post-graduation job opportunities are a key consideration for international students choosing between undergraduate programs in the U.S. and their

home country, then policies that reduce barriers to long-term employment for international students on F-1 visas are also recommended.

Conclusion

To the extent that foreign undergraduate students stay for graduate school or immigrate to the United States, and to the extent that immigrants are an important input to U.S. innovation and productivity, U.S. HEIs' competitiveness for Chinese students will likely shape the future of the U.S. economy and innovation enterprise. A substantial literature on international talent flows already documents how the flow of foreign students to U.S. schools has evolved over time. However, scholars have primarily focused on understanding the flow of students to U.S. graduate education programs—PhD programs in particular—ignoring the largest group of international students in the United States: undergraduates. In this paper, the author seeks to determine the extent to which increases to the quantity of undergraduate education options in China has influenced the quantity of Chinese undergraduate students enrolling at U.S. HEIs.

The author conducted a preliminary, non-causal analysis of this question using degree-disaggregated, time-series data of Chinese undergraduate enrollment at U.S. HEIs and Chinese HEIs. This analysis relies on data from three sources. Data from the Institute of International Education (IIE) track the enrollment of Chinese students at U.S. HEIs, disaggregated by degree level from 1997 to 2018. Data from the Chinese Ministry of Education (MOE) track the number of Chinese undergraduate students enrolled in Chinese HEIs, disaggregated by field of study from 1996-2018. Data from the U.S. Department of Homeland Security's Student and Exchange Visitor Information System (SEVIS) track the enrollment of Chinese undergraduate students at U.S. HEIs, disaggregated by field of study from 2005 to 2018.

This study finds that a rapid increase in Chinese enrollment at U.S. HEIs followed a simultaneous set of economic changes and U.S. immigration policy changes. In recent years, only in social science and non-S&E fields has the proportion of Chinese undergraduates enrolled at U.S. HEIs (as opposed to Chinese HEIs), continued to increase. In engineering fields, the proportion of Chinese undergraduates enrolled at U.S. HEIs has stagnated since 2014. Further research is needed to understand why the proportion of Chinese undergraduates enrolled in U.S. engineering programs stagnated while the same proportion for social sciences has continued to rise. Explanations might include field-specific discrepancies with respect to job market access and salaries in China or that students in social sciences are disproportionately attracted to the open academic environment at U.S. HEIs. Regardless, if policymakers aim to ensure that an increasing share of Chinese STEM students are trained in the United States, then policies should focus on STEM fields where the share of Chinese students at U.S. HEIs has peaked: engineering and biological sciences, but not other hard sciences such as mathematics, physics, and chemistry.

Two key sources of error limit the author's findings. First, the number of undergraduate students enrolled at Chinese HEIs (data from China's Ministry of Education) would also include students who grew up in other countries—not just China—and enrolled at a Chinese HEI. These individuals could bias the results. Second, Chinese students enroll in undergraduate programs across the world, not just those in the U.S. or those in China. Future work should expand the scope of this analysis to account for Chinese students who enroll in undergraduate programs in countries such as the United Kingdom, Canada, and Australia.

References

- Baer, Julie. 2018. Fall 2018 International Student Enrollment Hot Topics Survey. Washington, DC: Institute of International Education (IIE).
<https://www.iie.org/Research-and-Insights/Publications/Fall-2018-International-Student-Enrollment-Hot-Topics-Survey>
- Baer, Julie and Mirka Martel. 2020. Fall 2020 International Student Enrollment Snapshot. Washington, DC: IIE.
<https://www.iie.org/Research-and-Insights/Open-Doors/Fall-International-Enrollments-Snapshot-Reports>
- Bound, J., Braga, B., Khanna, G., & Turner, S. (2020). A Passage to America: University Funding and International Students. *American Economic Journal: Economic Policy*, 12(1), 97–126. <https://doi.org/10.1257/pol.20170620>
- Bradsher, K. (2013, January 17). Next Made-in-China Boom: College Graduates. Retrieved September 25, 2020, from <https://www.nytimes.com/2013/01/17/business/chinas-ambitious-goal-for-boom-in-college-graduates.html>
- Brown, J. D., Earle, J. S., Kim, M. J., & Lee, K. M. (2019). *Immigrant Entrepreneurs and Innovation in the U.S. High-Tech Sector* (NBER Working Paper). Retrieved from <https://www.nber.org/papers/w25565>
- Burchardi, K., Chaney, T., Hassan, T. A., Tarquinio, L., & Terry, S. (2020). Immigration, Innovation, and Growth. *SSRN Electronic Journal*.
<https://doi.org/10.2139/ssrn.3582182>
- Cai, Y. (2013). Chinese higher education: The changes in the past two decades and reform tendencies up to 2020. In L. d. C. Ferreira & J. A. G. Albuquerque (Eds.), *China and Brazil: Challenges and Opportunities* (pp. 91-118). Campinas: Anablumme.
- Camarota, S. A., & Jenks, R. (2003, December 1). Implementation of the Enhanced Border Security and Visa Entry Reform Act of 2002. Retrieved April 20, 2021, from <https://cis.org/Report/Implementation-Enhanced-Border-Security-and-Visa-Entry-Reform-Act-2002>

- Chellaraj, Gnanaraj, Keith E. Maskus, and Aaditya Mattoo. "The Contribution of International Graduate Students to US Innovation." *Review of International Economics* 16, no. 3 (2008): 444-62.
<https://doi.org/10.1111/j.1467-9396.2007.00714.x>.
- Chen, Mingyu. "The value of US college education in global labor markets: Experimental evidence from China." (2019).
- Cheng, E. (2019, June 4). China warns citizens against travel to the US. Retrieved April 20, 2021, from
<https://www.cnbc.com/2019/06/04/china-warns-citizens-against-travel-to-the-us.html>
- Doran, K., & Yoon, C. (2020). Immigration and Invention : Evidence from the Quota Acts. Retrieved from https://www3.nd.edu/~kdoran/Doran_Quotas.pdf
- Feng, E. (2020, September 23). As U.S. Revokes Chinese Students' Visas, Concerns Rise About Loss Of Research Talent. Retrieved April 20, 2021, from
<https://www.npr.org/2020/09/23/915939365/critics-question-u-s-decision-to-revoke-chinese-students-visas>
- Fischer, K. (2021, March 11). Is This the End of the Romance Between Chinese Students and American Colleges? Retrieved April 20, 2021, from
https://www.chronicle.com/article/is-this-the-end-of-the-romance-between-chinese-students-and-u-s-colleges?cid2=gen_login_refresh&cid=gen_sign_in
- Fish, E. (2018, February 3). How Chinese overseas students are learning harsh life lessons. Retrieved April 20, 2021, from
<https://www.scmp.com/magazines/post-magazine/long-reads/article/2131738/how-chinese-overseas-students-are-learning-harsh>
- Huifeng, H. (2020, September 21). China's overseas graduates return in record numbers into already crowded domestic job market. Retrieved April 20, 2021, from
<https://www.scmp.com/economy/china-economy/article/3102384/chinas-overseas-graduates-return-record-numbers-already>
- Hunt, J., & Gauthier-Loiselle, M. (2010). How much does immigration boost innovation. *American Economic Journal: Macroeconomics*, 2(2).
<https://doi.org/10.1257/mac.2.2.31>
- Illegal Immigration Reform and Immigrant Responsibility Act of 1996*. (1996). Washington D.C.

- Information About the Department of Justice's China Initiative and a Compilation of China-Related Prosecutions Since 2018. (2021, March 9). Retrieved April 20, 2021, from <https://www.justice.gov/nsd/information-about-department-justice-s-china-initiative-and-compilation-china-related>
- Institute of International Education (IIE). 2020. Open Doors: Report on International Educational Exchange. Washington, DC: IIE. <https://www.opendoorsdata.org/>
- Institute of International Education (IIE). (2020). "International Students by Academic Level and Place of Origin, 2000/01-2019/20." Open Doors Report on International Educational Exchange. Retrieved from <http://www.opendoorsdata.org>.
- Jing, M. (2019, June 13). Trump's academia clampdown risks scaring Chinese talent away. Retrieved September 25, 2020, from <https://www.scmp.com/tech/policy/article/3014185/why-trumps-clampdown-academia-forcing-many-chinese-researchers>
- Kerr, S. P., Kerr, W., Ozden, C., & Parsons, C. (2016). Global talent flows. *Journal of Economic Perspectives*, 30(4), 83–106. <https://doi.org/10.1257/jep.30.4.83>
- Khanna, G., & Lee, M. (2018). *High-Skill Immigration, Innovation, and Creative Destruction*. <https://doi.org/10.2139/ssrn.3207942>
- Khanna, G., Shih, K., Weinberger, A., Xu, M., & Yu, M. (2020). Trade liberalization and Chinese students in US higher education. SSRN Electronic Journal. doi:10.2139/ssrn.3590272
- Li, H. (2010). Higher Education in China: Complement or Competition to US universities? American universities in a Global Market.
- Li, W. (2001). Enter into wto and Chinese education reform (in Chinese). *Education Research*(12), 3-6.
- Li, Y., Whalley, J., Zhang, S., & Zhao, X. (2012). The higher educational transformation of China and its global implications. In *The Globalization of Higher Education* (pp. 135–162). Palgrave Macmillan. <https://doi.org/10.1057/9781137265050>
- Ma, Y. (2020). *Ambitious and Anxious*. *Ambitious and Anxious*. <https://doi.org/10.7312/ma--18458>

- Maslak, Anatoli A., George Karabatsos, Tatijana S. Anisimova, and Sergei A. Osipov. "Measuring and comparing higher education quality between countries worldwide." *Journal of Applied Measurement* 6, no. 4 (2005): 432.
- Moser, P., Voena, A., & Waldinger, F. (2014). German Jewish Émigrés and US Invention. *American Economic Review*, 104(10). Retrieved from <https://www.aeaweb.org/articles?id=10.1257/aer.104.10.3222>
- Moules, J. (2020, October 27). Coronavirus boosts Chinese schools' domestic appeal. Retrieved April 20, 2021, from <https://www.ft.com/content/105a3fb5-c496-4d00-9ebf-b740179b18a6>
- New NAFSA Data: Despite Stagnant Enrollment, International Students Contribute Nearly \$41 Billion to the U.S. Economy. (2019, November 18). Retrieved April 20, 2021, from <https://www.nafsa.org/about/about-nafsa/new-nafsa-data-despite-stagnant-enrollment>
- Nylander, J. (2015, September 15). China's Investment In Elite HEIs Pays Off: New Ranking. Retrieved September 25, 2020, from <https://www.forbes.com/sites/jnylander/2015/09/14/chinas-investment-in-elite-universities-pays-off-new-ranking/>
- Project 211 and 985. (n.d.). Retrieved April 20, 2021, from <https://www.chinaeducenter.com/en/cedu/ceduproject211.php>
- QS Graduate Employability Rankings 2020. (2021). Retrieved April 20, 2021, from <https://www.topuniversities.com/university-rankings/employability-rankings/2020>
- Redden, E. (2019, June 4). Chinese officials warn students of visa problems if they come to U.S. Retrieved April 20, 2021, from <https://www.insidehighered.com/news/2019/06/04/chinese-officials-warn-students-visa-problems-if-they-come-us>
- Redden, E. (2018, May 30). U.S. to Limit Visa Length for Some Chinese Students.
- Ruiz, Neil G. 2014. *The Geography of Foreign Students in U.S. Higher Education: Origins and Destinations*. Washington, DC: Brookings Institution. <https://www.brookings.edu/interactives/the-geography-of-foreign-students-in-u-s-higher-education-origins-and-destinations/#/M10420>
- Schleicher, A. (2019). *PISA 2018 - Insights and Interpretations*. Retrieved April 20, 2021, from

<https://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf>

Sevastopulo, Demetri. "US Considered Ban on Student Visas for Chinese Nationals." Financial Times, October 2, 2018.

<https://www.ft.com/content/fc413158-c5f1-11e8-82bf-ab93d0a9b321>.

Stapleton, K. (2017). China now produces twice as many graduates a year as the US. Retrieved April 19, 2021, from

<https://www.weforum.org/agenda/2017/04/higher-education-in-china-has-boomed-in-the-last-decade>

Stuen, E. T., Mobarak, A. M., & Maskus, K. E. (2012). Skilled Immigration and Innovation: Evidence from Enrolment Fluctuations in US Doctoral Programmes. Economic Journal, 122(565), 1143–1176.

<https://doi.org/10.1111/j.1468-0297.2012.02543.x>.

U.S. Extends Visa Validity for Chinese Students and Exchange Visitors. (2005).

Retrieved April 19, 2021, from

<https://2001-2009.state.gov/r/pa/prs/ps/2005/47974.htm>

U.S. Immigration and Customs Enforcement (ICE). 2020. SEVIS by the Numbers: Annual Report on Nonimmigrant Student Trends. Washington, DC: ICE.

<https://www.ice.gov/doclib/sevis/pdf/sevisBTN2019.pdf>

Wan, X. (2020). *Chinese Students Wary of Studying in the United States*. Retrieved from

<https://www.internationalhighereducation.net/api-v1/article/!/action/getPdfOfArticle/articleID/2886/productID/29/filename/article-id-2886.pdf>

Wong, E., & Barnes, J. (2020, May 28). U.S. to Expel Chinese Graduate Students With Ties to China's Military Schools. Retrieved September 25, 2020, from

<https://www.nytimes.com/2020/05/28/us/politics/china-hong-kong-trump-student-visas.html>

Yan, A. (2020, July 18). Chinese students turn away from US universities with Britain the big winner. Retrieved April 20, 2021, from

<https://www.scmp.com/news/china/society/article/3093614/chinese-students-turn-away-us-universities-britain-big-winner>

Yu, Y., Ting-Fang, C., Li, L., & Liu, C. (2020, September 2). Trump and COVID force Chinese students to rethink the US. Retrieved April 20, 2021, from

<https://asia.nikkei.com/Spotlight/The-Big-Story/Trump-and-COVID-force-Chinese-students-to-rethink-the-US>

Zwetsloot, R., Feldgoise, J., & Dunham, J. (2020). Trends in U.S. Intention-to-Stay Rates of International Ph.D. Graduates Across Nationality and STEM Fields. Washington D.C. Retrieved from <https://cset.georgetown.edu/research/trends-in-u-s-intention-to-stay-rates-of-international-ph-d-graduates-across-nationality-and-stem-fields/>

Appendix A

Table A1: Factors that could impact the quality of Chinese HEIs.

Increase in PRC funding of top HEIs (Projects 985 and 211) coupled with reduction in corruption	Changes to whether Chinese HEIs have the resources and faculty that they need
Chinese educated abroad return to China and accept professorships	
Student to faculty ratio widens further as enrollment rapidly expands	
Chinese parents realize that degrees from Chinese HEIs are not sufficiently qualifying Chinese students for jobs	Increased demand for <i>better</i> higher education
Creation of <i>Higher Education Evaluation Centre</i>	Central government policies emphasize the importance of improving education quality and implement more rigorous educational standards.
Action Plan for Invigorating Education 2003-2007	
Changes to financial and promotional incentives for Chinese faculty to publish in top journals	Changes in how faculty at Chinese HEIs allocate time/effort between teaching and research
Chinese HEIs hire younger, less experienced faculty to support expanded number of students	Average quality of instruction in Chinese HEIs falls

Table A2: Factors that could impact the quality of Chinese students at U.S. HEIs.

Chinese HEIs become more/less globally competitive in specific fields	Chinese students become more/less interested in studying abroad
Changing job opportunities in China (<i>not totally convinced</i>)	
Changing nationalist views of Chinese students	
Chinese government encourages/discourages Chinese students from studying abroad	
U.S. HEIs improve recruitment tactics/incentives to attract <i>top</i> Chinese undergrads	Top Chinese students who want to study abroad increasingly/decreasingly prefer U.S. HEIs over those in other countries (e.g. U.K., Canada, E.U.)
Non-U.S. HEIs improve recruitment tactics/incentives to attract <i>top</i> Chinese undergrads	
Chinese government encourages/discourages Chinese students from studying at U.S. HEIs	

Appendix B

Figure B1: Number of Chinese students enrolled at U.S. HEIs, 1997-2018

