"Will the U.S. Keep the Best and the Brightest (as Postdocs)?
Career and Location Preferences of Foreign STEM PhDs"

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October 31, 2017

A key factor behind the persistence of U.S. leadership in STEM fields has been its ability to attract and retain top tier talent from other countries. Foreign students represent half or more of PhD students and they are more productive during the PhD than natives (Gaule & Piacentini 2013, Stuen, Mobarak & Maskus 2012). More generally, the foreign born make disproportionate contributions to U.S. science and engineering (Levin & Stephan 1999).

Talented foreigners have typically come to the U.S. as graduate students and stayed in the U.S. in academic or industry careers. An especially common career path among foreign students is obtaining a postdoctoral position upon graduation. Postdocs, while important part of the scientific labor force, are characterized by low-pay and uncertain career trajectories. The NSF estimates that over 57 percent of postdocs in STEM fields were in the US on temporary visas in 2015; in Chemistry, temporary visa holders were 64 percent of postdocs (NSF, 2017). Yet relatively little is known both about postdoc careers in general and the transition from the PhD to postdoc for foreign students in particular. It has been documented that individuals in US graduate programs with foreign bachelor's degrees and/or on temporary visas are more likely to take postdoc positions after graduation compared to US counterparts, likely because individuals in the US on temporary visas are constrained in their employment opportunities due to visa restrictions (Stephan and Ma, 2005; Amuedo-Dorantes and Furtado, 2017). One reason foreign students may prefer and ultimately end up in postdoc positions is that academic institutions are not subject to H-1B visa caps. For example, Amuedo-Dorantes and Furtado (2017) provide evidence suggesting that the visa restrictions lead students to 'settle' for academia.

This points to an important issue with aggregate estimates of the number of postdocs who are foreign and of the number of foreign students taking post-docs – these estimates are the result of both supply- and demand-side factors and thus fail to shed light on the supply-side factors driving the potential differential entry of foreign students into postdoc positions. In other words, we still know very little about the *preferences* of foreign students for pursuing a post-doc and for staying in the US *while they are still graduate students*, and whether these preferences vary by the caliber of the student.

Our study contributes to the existing literature by focusing on the supply side of the market, by identifying and comparing the preferences of foreign and US graduate students for a postdoc and academic vs. industry career. We leverage data from a novel survey we conducted of 1,153

current doctoral students in a major STEM field – Chemistry – conducted in 2017 at 50 U.S. institutions about their career and location preferences.

First, we estimate the *career preferences* of foreign and US STEM students for different types of post-graduation jobs – postdocs, industry, or teaching positions – using both hypothetical choice methods and more standard Likert measures of preferences for different careers. Using a large sample of students across a range of departments, we are able to compare the preferences of foreign and US students within the same PhD program and area of specialization. We find that foreign students are much more likely to prefer a post-doc position upon graduation, reporting a 11-percentage point higher likelihood of accepting a post-doc position at a top university compared to US students on average. US and foreign students both similar place the highest preferences on industry jobs, but our results point to a notable difference in the types of academic jobs they prefer; foreign students value research-oriented academic careers more than US students (post-doc jobs), while US students value teaching more (see Table A1). Since neither research nor teaching institutions would be subject to H-1B caps, it is unlikely that the difference in preferences for teaching vs. research are due to potential visa restrictions. We further find that both higher and lower ability foreign PhD students have consistently higher preferences for a postdoc than their US counterparts, where we measure ability both by self-reported GRE scores; we will be linking the survey data to publication records soon to obtain more objective measures of ability.

Second, we examine students' *location preferences* using a novel revealed preference approach based on a hypothetical choice method. Here, we ask each respondent to report how likely (in terms of percent chances out of 100) they are to choose a postdoc position when given pairs of postdoc offers, where the offers include postdoc positions in top-50 Chemistry departments both in U.S. and non-U.S. universities (based on the Shanghai ranking). While respondents across the board have a strong preference for U.S. locations, foreign students are even more likely to prefer US locations. We estimate that foreign students are 7 percentage points more likely to choose a (hypothetical) postdoc offer in the U.S. than in a non-U.S. department, even when controlling for the difference in the rank of the programs and baseline preferences for doing a postdoc, and when comparing students within the same PhD program.

We proceed to use the counterfactual job questions to construct a revealed-preferences ranking of universities as locations to do a chemistry postdoc. Our approach is based on the same principles as Avery et al.'s (2012) revealed preference ranking of U.S. colleges, and leverages the ELO ranking method that is used to rank chess players and is used in other competitive settings where players are ranked based on head-to-head competitions. Besides generating an ordinal ranking list, this ranking system enables us to measure the intensity of preferences. We generate both an overall ranking and separate rankings reflecting the revealed preferences of American and foreign students respectively.

A comparison between our rankings and the Shanghai ranking suggest that U.S. Universities are perceived as more desirable as a place to do a postdoc than a bibliometrics-based ranking suggests. The Japanese, Chinese and Middle Eastern universities in our sample rank very low in the revealed preferences ranking despite achieving research excellence based on scientific output and international recognition. Comparing the preferences of U.S. and foreign revealed references, we find that foreign students are less interested than U.S. students in non-U.S. locations. For instance, the University of Cambridge is third in the ranking of U.S. students versus

17th in that of foreign students. Foreign students rank Harvard especially highly, likely due to prestige, which is consistent with findings from Stephan et al (2013) about the excellence/prestige of U.S. institutions in leading students to choose the U.S. for a postdoc; U.S. students, meanwhile, appear less attracted by institutional prestige.

In sum, our findings show the foreign and U.S. Chemistry Ph.D. students have significantly different preferences for careers, with foreign students being much more likely to prefer doing a postdoc. Foreign students also value a U.S. location more than U.S. students, and their revealed preference ranking of locations for postdoc differ in many ways. Our results suggest the U.S. will manage to retain talented foreign graduate students and no brain exodus is in sight.

References

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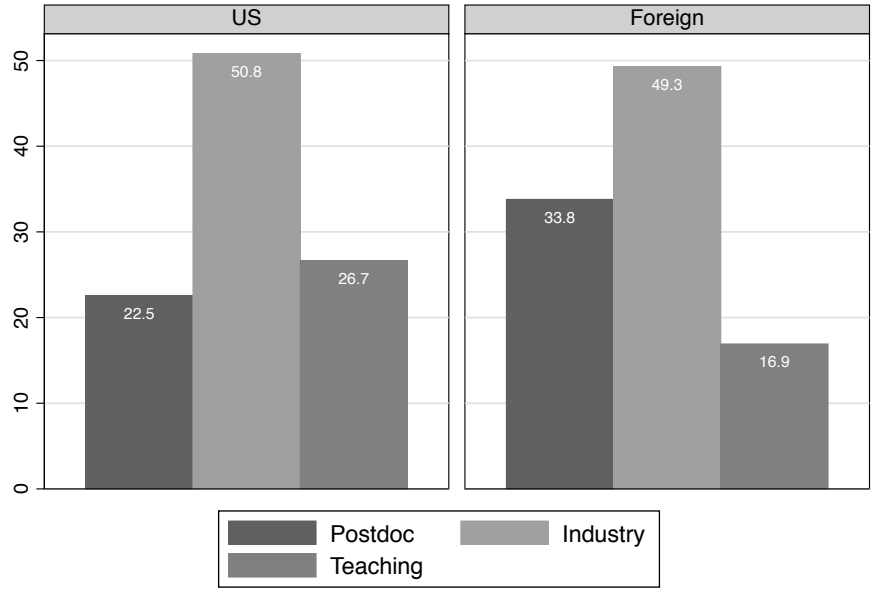
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Appendix

Table A1: Preferences for Jobs, US and Foreign Students



Notes: Based on hypothetical job offer question where survey respondents were asked the likelihood (out of 100) of choosing offers from industry, postdoc at a top university, or teaching institution.

Table A2: Shanghai and revealed preferences rankings (top 10)

	Shanghai Chemistry rankings	Revealed preferences ranking - U.S. students	Revealed preferences rankings - foreign students
1	UC Berkeley	Caltech	Harvard University
2	Harvard University	University of Colorado	Caltech
3	Stanford University	University of Cambridge	MIT
4	Caltech	MIT	UC Berkeley
5	Northwestern University	UC San Diego	Stanford University
6	MIT	Northwestern University	UC Santa Barbara
7	University of Cambridge	University of California, Irvine	UC San Diego
8	ETHZ	Stanford University	Yale University
9	Kyoto University	UCLA	USC
10	University of Pennsylvania	UC Berkeley	UCLA

Notes: The revealed preferences ranking is calculated using the ELO ranking method and is based on answers to hypothetical job questions where survey respondents choose between pairs of post-doc offers.