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Wait Time for Permanent Residency and the Retention of Immigrant Doctoral Recipients in the U.S.

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Abstract

More than 65 percent of foreign doctoral recipients continue to stay and work in the U.S. after graduation. Using data from the Survey of Earned Doctorates, the Survey of Doctoral Recipients and U.S. Citizenship and Immigration Services (USCIS), this paper estimates the impact of wait-times for permanent residency (Green Card Status) on the migration decisions of foreign doctoral recipients graduating from U.S. universities. The results indicate that for a recent immigrant doctoral recipient an additional year of wait-time decreases the probability he or she still lives in the U.S. by 5.5 percentage points. I also find that the negative impact of wait-time on immigrant's retention in the U.S. is temporary. Five years after graduation there is no difference in retention between foreign doctoral recipients who faced long Green Card wait -times and those who faced none.

Key words: Immigration, Green Card, H1-B visa, Stay Rates, USCIS, Priority Date

JEL codes: K 37, J15, and J60

1.1 INTRODUCTION

The topic of illegal immigration often dominates the U.S. immigration debate, but legal highskilled immigration is often overlooked. The proposed immigration reform of 2016, however, has prioritized reducing barriers for immigrant high-skill workers to work within U.S. On approval, this bill would resolve the massive backlog of pending Green Card applications, and would allow temporary visa holders to switch jobs more easily while waiting for permanent residency. Delays in receiving permanent residency and restrictions attached to temporary work visa may affect an immigrant's intentions to stay in the U.S. These proposed reforms may improve retention of immigrant scholars, scientists and researchers graduating from U.S universities. Recent studies show no negative impact of immigration on wages and unemployment. Birgeir (2017) using two different types of multilevel models: A cross-sectional and a lagged dependent model on US population found that in most years, the increase in immigrants' occupational share is not related to a decline in native wages. Fromentin (2013) Using a system of equations for unemployment, immigration, wage and gross domestic product, observed no increase in aggregate unemployment due to immigration in the long run in France. Maskus et all (2010) in their study found Both US and international students contribute significantly to the production of knowledge at scientific laboratories, and their contributions are statistically comparable. Visa restrictions limiting entry of high-quality students are found to be particularly costly for academic innovation.

This study uses data from the Survey of Earned Doctorates (SED), the Survey of Doctoral Recipients (SDR) and the U.S. Citizenship and Immigration Services (USCIS), to evaluate the impact of wait-times for permanent residency (Green Card Status) on the migration decisions of foreign doctoral recipients graduating from U.S. universities. Ph.D. recipients from some countries such as China and India have to wait five to ten years to acquire permanent residency status within U.S., in addition to the time these immigrants have already spent in the country as graduate students. The econometric analysis in the paper uses country and year fixed-effects regression specification, taking advantage of the exogenous variation in wait-time that depends on immigrant's country of origin and year of graduation. The analysis focuses Note: "The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusion contained in this report."

on three questions: First, does wait-time for permanent residency affect an immigrant's plans to stay within U.S immediately after graduating from a U.S university? Second, what is the impact of wait-time on actual retention of these foreign born doctoral recipients? Third, is any impact of wait-time on the retention of immigrant doctoral recipients in the U.S. persistent or temporary?

The SED annually surveys individuals receiving research doctoral degrees from U.S institutions in a particular calendar year. These data are used to analyze immigrant doctoral recipients' plans to stay in the U.S. immediately after graduation. The SDR surveys are biennial longitudinal data, drawn from the SED sample, that provide a seven percent sample of persons obtaining their doctoral degree in the United States. While the SED only surveys newly graduated doctoral recipients, the SDR surveys follow cohorts of doctoral graduates over time. I use 2010 and 2013 SDR surveys to estimate the impact of GC wait-time on the location decisions of immigrants receiving their Ph.D. between 2001 and 2013. The information on Green Card (GC) wait-times is available on USCIS website, and matched to immigrants using country of birth and year of graduation recorded in the SED and SDR data.

The results indicate that an additional year of wait-time decreases the probability of retention of fresh immigrant doctoral recipients (0-2 years since graduation) by 5.5 percentage points. The current (Jan 2016) predicted wait-times from India and China are ten and six years respectively. This can decrease probability of retention of fresh graduates (0-2 years since graduation) from these two countries by one-half and one-third respectively. However, the results indicate that the impact of wait-time on the retention of immigrant Ph.D. recipients is temporary and not persistent. For immigrant doctoral recipients between 3 and 5 years since graduation the impact decreases to 1.2 percentage points, and, for the immigrants at least 6 years past graduation there is no effect of wait-time on immigrant's retention in the U.S.

Previous studies have analyzed the impact of visa restrictions on source and receiving countries' knowledge economies. However, there is a dearth of research analyzing the impact of these visa Note: "The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusion contained in this report."

restrictions on the retention of immigrant doctoral recipients graduating from U.S. universities. Finn M.G (2012, 2014) studied trends in the stay-rates of doctoral recipients from U.S universities and concluded that stay-rates vary substantially by country of citizenship. This is the first study to analyze the impact of wait-time for permanent residency on the immediate and long term retention of immigrant doctoral recipients graduating within U.S.

1.2 INSTITUTIONAL BACKGROUND ON VISAS AND PERMANENT RESIDENCY

The paper evaluates the retention of immigrants who graduated with Ph.D.s from universities in the United States. In 2009, 33 percent of the doctoral degrees within U.S. were earned by foreign students. In all, these international graduate students accounted for 50 percent of degrees in the physical sciences, 67 percent in engineering and 68 percent in economics (Bound, Turner and Walsh, 2009). More than 65 percent of these foreign graduates continue to stay and work in U.S. after graduation (Borjas, 2009). As students in the United States, these immigrants are mostly on F-1 visas¹, which allow international students to pursue education in the United States. After graduation, F-1 students who become employed in the United States may switch to H1-B visas, if they are sponsored by their employers. The H1-B visa program is designed for temporary workers employed in "specialty occupations". The specialty occupations require specialty knowledge and at least a bachelor's degree or its equivalent. On this visa status immigrants can work in the U.S up to three years from the date of sponsorship, and then the visa requires renewal after every three years². While immigrants are on H1-B visa, they are tied to the sponsoring firm, they cannot leave their employer within U.S., and if they get

¹ Except immigrants from Canada and Mexico they get F-3 visas. These are for "border commuters" who reside in their country of origin while attending school in the United States. These are granted to nationals of Mexico or Canada only and these visa holders may study part time –or full time.

² The H1-B Visa is renewable at least up to 6 years. Renewal after 6th year depends on status of PERM application. Note: "The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusion contained in this report."

laid-off they are required to leave the country, unless they succeed in finding a new sponsoring employer. While on H1-B visa status, immigrants are eligible to adjust their status to become legal permanent residents (LPR) or Green Card (GC) holders. Once an immigrant receives GC status they are free to look for other employment opportunities and can start their own businesses and consultancies³. Recently graduated doctoral recipients' who do not have H1-B sponsorship from the employer have an option to remain and work within United States for one to two years on the OPT (optional practical training) status. However, they cannot file for GC on this status⁴.

When these immigrants apply to become legal permanent residents, the wait-time depends on their country of birth and date of acceptance of the GC petition. If an immigrant is from any country except China and India the change of status from H1-B to GC is immediate. However, for an immigrant from China and India, because of high volumes of GC petitions from these countries in the EB-2 (high–skilled) category, and limited annual per country quotas, the status change from H1-B to GC takes years⁵. For example, take two immigrants on H1-B, one from the U.K. and other from India. Assume for both immigrants the GC applications are accepted in January, 2016. There is no wait-time for the immigrant from the U.K.. Because U.K. never exceeds the quota, there is no backlog, and his visa status is changed immediately to GC. In January, 2016 however, the USCIS was only granting GC status to immigrants from India whose application had been accepted in August 2008. Because of this backlog, the immigrant from India has an estimated wait-time of 7.52 years for permanent residency.

³ The current law limits to 65,000 the number of foreign nationals who may be issued a visa or otherwise provided H1-B status each fiscal year. Laws exempt up to 20,000 foreign nationals holding masters or higher degree from the U.S. universities from the cap on H1-B visas.

⁴ Optional Practical Training (OPT) is a period during which undergraduate and graduate students with F-1 status who have completed or have been pursuing their degrees more than nine months are permitted by the United States Citizenship and Immigration Services (USCIS) to work at most one year on the student visa within the country. For students qualifying in STEM fields (Science, Engineering, Technology and Mathematics) there is a 17-month extension on the OPT.

⁵ 140,000 GC permits are issued annually. The per country quota is 7 percent of the total.

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The United States Department of State publishes a monthly Visa Bulletin⁶, which lists cut-off dates for different immigration categories and countries of birth. The Jan 2016 EB-2 cutoff date for China is March 2012, for India is August 2008, and for all other countries it is Jan 2016 (current).

While waiting for GC, immigrants who remain in the U.S. must remain on the temporary work visa, and are subject to its restrictions on job mobility. If immigrants' GC applications are not approved before the expiration of their temporary visa and all its legal possible extensions, they may have to leave the country (Kirkegaard, 2007). The uncertainties attached to working on H1-B may make working in the U.S. after graduation less attractive for immigrants who face longer GC wait-times.

1.3 IMPACT OF GC WAIT-TIME ON MIGRATION CHOICES OF FOREIGN DOCTORAL RECIPIENTS

Let us assume for simplicity that after graduation new doctoral recipients have three options: One, leave to home country immediately after graduation; two, stay temporarily within the U.S. and then go back to the home country; three, stay permanently in the U.S.

<u>Case I:</u> Let us assume that the work experience accumulated within U.S. does not have any additional value in the immigrant's home country, and that the cost of returning to home country increases over time. When the doctoral immigrants compare their expected life-time earnings in the U.S. and home country respectively, they will stay in the U.S if expected life-time earnings within U.S are higher; else they will leave immediately after graduation.

Now, let us add delays in GC status for some immigrants to our assumption above. These delays will compel some immigrants to work on H1-B visas for longer durations; this will further restrict

⁶ Visa Bulletin is a publication regarding immigration to the United States published by the United States Department of the State. The primary purpose of this bulletin is to provide an update waiting list (also known as Priority Date) for immigrants that are subject to the quota system.

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employment opportunities within U.S. for the immigrants working on H1-Bs compared to other immigrants, lowering the expected life-time earnings within U.S. compared to immigrants from countries with no GC waits. This could cause immigrant doctoral graduates from countries with long GC waits to exit the U.S. immediately after graduation at higher rates.

<u>Case II:</u> Here we assume that immigrant doctoral recipients receive positive returns to the U.S. work experience when they return to work in their home country. In this case, in order to maximize their lifetime earnings, these immigrants may choose first to accumulate U.S work experience before returning to their home country. That is, there will be some temporary stayers. Further, assuming that there are diminishing returns to accumulative U.S. experience, and the cost of transition back increases with time spent in the U.S., these temporary stayers may prefer to exit U.S. at their early to mid–career points. With perfect information and no wait-time for GC status, immigrant doctoral recipients choose their optimal stay durations in the U.S to maximize their aggregate life time earnings. However, with the long GC waittime and the limitations on H1-B visas, the optimal–stay duration of these immigrants will likely be reduced. These immigrants on temporary work visas are likely to exit the country earlier, compared to the optimal exit duration they would have if they had their GC status.

1.4 DATA

The analysis uses data from Survey of Earned Doctorates (SED) and the Survey of Doctorate Recipients (SDR). These data files provide detailed information on educational attainment and career outcomes of doctoral recipients graduating from U.S universities⁷.

⁷ The data set for these high-skilled workers is maintained by the National Science Foundations. The National Science Foundation has two websites that provide detail descriptions of the SED and SDR data sets. The SED website is http://www.nsf.gov/sbe/srs/ssed/sedmeth.htm; and the SDR website is http://sestat.nsf.gov. The data used for analysis in the paper are available from the NSF under a licensing agreement designed to guard the confidentiality of the survey participants.

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The SED annually surveys individuals graduating with research doctoral degrees from U.S institutions. The SED response rate is around 92 percent. This data set is a rich source of information on new doctoral recipients. The SED asks the recent doctoral graduates if they intend "to live, work, or study in the U.S after graduation". I use this information to analyze whether the waiting period to procure a Green Card (GC) affects intentions to stay and work within the country after graduating from U.S universities. I restrict my analysis to immigrants who received their doctoral degree between 1990 and 2010. The data includes both immigrant doctoral graduates entering U.S. as graduate students and immigrants entering U.S. as under-graduate students and then entering graduate schools for doctoral degrees. I identify "immigrants" in the data set to be an individual who is either a naturalized citizen or a non-citizen. To identify native country, I use information on birth country, country of high school and country where Bachelor's degree was awarded. In order to reduce miss-measurement of home country, only individuals having high school country same as birth country or country where Bachelor's was awarded is same as birth country of individuals matched with either country of high school or country where Bachelors degree was awarded.

The SED provides information on doctoral recipients' intentions to remain in the U.S. but does not follow recipients over time. The SDR is a biennial longitudinal data of doctoral recipients drawn from the universe of respondents in SED. A sample of newly minted doctorates is added to the sample every two years and a "maintenance cut" of older doctorates is conducted in order to keep the sample size relatively constant at around 30,000 per wave. I restrict my analysis to immigrant graduates only.

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The analysis uses the 2010 and 2013 SDR waves; these waves use integrated design ensuring proper representation of PhD. graduates from U.S. universities who live outside the U.S⁸. The analysis uses the SDR 2010 and 2013 sample weights⁹.

GC wait-times are calculated using the U.S. government's visa bulletins, which are available on the United States Citizenship and Immigration Services (USCIS) website. The Visa Bulletins publish country-specific GC cut–off dates for each month in a year. Here I present a simple example to explain the wait-time calculation for GC status. Let us assume that a hypothetical individual graduates on April 1st 2013. I assume that it takes about a year to submit and get the GC petition accepted by USCIS. Adding this year, I expect that the USCIS will accept the application of this immigrant by April 1st, 2014. If on April 1st, 2014 GC cut-off date for the immigrant's country is April 1st, 2014, that is current or later, then the expected wait-time for this hypothetical immigrant is 0. Whereas, if on April 1st 2014 the GC cut-off date for the immigrant's country is November 1st 2008, then the expected wait-time for this hypothetical individual is estimated as follows : (April 1st 2014 – November 1st 2008) calculated in years . That is 5.46 years.

Table 1 shows number of Ph.D. graduates receiving doctoral degrees in the U.S. from selected countries. The three countries accounting for most doctoral degrees are China, India and Korea. Further,

⁸ Traditionally SDR collected information on residing individuals with doctoral degrees. Beginning 2003, cycle the International Survey of Doctorate Recipient (ISDR) to represent U.S. trained doctorate recipients living outside U.S. was added. However there were some weighting and representation issues. From 2010 onwards National Science Foundation (NSF) developed a methodology to integrate National SDR and International SDR to assure true representation of doctoral recipients from U.S. living within or outside the country. The integrated design used in these surveys ensure coverage for all domains, thus individual migration has no negative impact on the frame of coverage. For more details see

www.amstat.org/sections/SRMS/proceedings/y2012/Files/305856_75526.pdf

⁹ Chang and Milan (2008) in their paper "International Mobility and Employment Characteristics among Recent Recipients of U.S. Doctorates" have used integrated SDR 2008 data sets to analyze the international mobility of recent doctoral graduates. The SDR 2008 data set is not available for public use. However, the data collection procedure and National SDR and International SDR integration of SDR 2010 and 2013 is based on SDR 2008 standards. For more details see www.nsf.gov/statistics/infbrief/nsf13300/

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it is clear from Table 2 that most doctoral graduates from China, India and Iran intend to stay and work in the U.S. after graduation¹⁰. An important thing to notice here is that China and India not only account for leading number of doctoral graduates, but these two countries also account for major proportion of graduates intending to stay and work in the U.S.. Table 1 and Table 2 together indicate that there is a large pool of doctoral candidates from China and India in the work force. This excessive supply of Chinese and Indian doctorate recipients quickly fills up the country–specific GC quota in EB-2 category. As a result immigrants from these two countries often face extensive wait-times for GC status.

Figure (1) and Figure (2) Panel-A shows average yearly GC wait-time in months for China and India respectively. Panel-B shows fraction of new doctoral graduates from China and India respectively intending to stay in the U.S. immediately after graduation. For China we observe that average wait-time in months for GC is increasing over the years and, though most recent doctoral graduates (more than 80 percent) intend to stay, there is a noticeable drop in fraction of recent doctoral graduates intending to stay in the U.S. after graduation. However, for India we don't observe any such patterns. There is no visible relationship between GC wait-time and intentions to stay and work in the U.S for doctoral graduates from India, graduating from the U.S. universities.

1.5 REGRESSION ANALYSIS

I first analyze the effect of wait-times for Green Card (GC) on intentions to stay in the U.S. immediately after graduation, using SED–DRF Files 1985 onwards. The regression specification is:

$$IntStay_{ict} = \alpha + \beta(EW_{ct}) + \Re K_{it} + \nu S_{it} + \pi_c + \partial_{ft} + e_{ict}$$
(1)

¹⁰ The intention data from SED have been good predictors of the one year (immediate years) stay rates for over a decade – Michael G. Finn " Stay Rates of Foreign Doctorate Recipients from U.S. universities, 2011

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In equation (1) our unit of observation is individual (i), from country of origin (c), graduating in survey year (t). The dependent variable is an indicator variable where '1' indicates that the respondent intends to stay and work within U.S after graduation and '0' indicates that he or she plans to leave U.S after graduation.

The explanatory variable Expected Wait–time (EW) varies by immigrant's birth country (c) and year of graduation (t). K_{it} is a vector containing demographic controls including age, age-square, age at the time of entering PhD. program, gender, and marital status. S_{it} is a vector of education and individual's quality controls which contains variables indicating school quality and education background. To measure quality, PhD. programs are categorized into three groups using the National Research Council's valuations of Research Doctoral Programs, 2010^{11} . The ranking of undergraduate school is based on the similar algorithm as used by Maskus et all, 2010^{12} , which is also compressed into three categories. The vector also includes controls for change in field of education between undergraduate and masters, and between masters and Ph.D., and indicators for field of majors. Vector π_c represents country of origin fixed effects. ∂_n is the interaction of year of graduation and field of major dummy variables. These interactions account for the possibility that the intentions to stay differ for different field of study over time due to change in field specific job opportunities within the United States. The paper uses cluster-robust standard error proposed by White (1984, p.134-142) for estimation. The standard errors are clustered at country level.

¹¹ The information about the Doctoral Program Ranking can be obtained from <u>http://sites.nationalacdemics.org/PGA/Resdoc/index.htm</u>

¹² Maskus et all in their paper "Skilled Immigration and Innovation : Evidence from Enrollment fluctuations in U.S. Doctoral Programs" have used an algorithm to rank the undergraduate schools . I have used the algorithm provided by them to rank undergraduate school quality in four bins. That is I have compressed the ranking into four quartiles. For more information see papers.ssrn.com/sol3/papers.cfm?abstract_id=1559665

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Next, the paper uses SDR (NSDR and ISDR) 2010 and 2013 data to evaluate how wait-time effects the location decisions of immigrant doctoral recipients who have graduated from U.S. universities since 2001. This regression specification allows the impact of expected wait-time at graduation to differ by time since graduation. This allows us to investigate whether the effect of GC wait-time on retention of immigrant Ph.D. recipients from U.S. universities is short term or long term.

$$INUS_{icgt} = \alpha + \sum_{n=1}^{4} \beta_n (GR_{nt} \times EW_{cg}) + \Re K_{it} + \nu S_{it} + \pi_c + \partial_{ft} + \pi_{gt} + e_{icgt}$$
(2)

In Equation (2), the dependent variable INUS is an indicator variable, which is equal to '1' if immigrant doctoral recipient is located in the U.S and '0' otherwise. Immigrants are divided into four group intervals based on time since graduation are 0-2 years, 3-5 years, 6-8 years and 9-11 years. GR_{nt} is an indicator for immigrant's group interval (n) in the survey year (t). EW_{cg} is the estimated wait-time for GC for individuals from country (c) graduating in year (g). The terms π_{gt} denote Survey * Cohort effects, allowing the cohort fixed effects to vary across surveys. The rest of the notations are the same as in Equation (1).

In this equation β_n 's allow the effects of GC wait-time at time of graduation to change with time since graduation. Differences in β_n 's across the four categories reflect both time and cohort effects. For instance, it is likely that for a particular cohort, the effect of wait-time in year of graduation is different three years after graduation compared to six years after graduation. At the same time it is also possible that the impact of wait-time three years after graduation is different for cohorts who graduated in year 2004, compared to those who graduated in year 2007.

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Since we have two waves of the Integrated SDR data, 2010 and 2013, and additionally we have repeated observations of the same cohorts, this allows us to interact the $GR_{nt} \times EW_{cg}$ terms with an indicator to survey year 2013.

$$INUS_{icgt} = \alpha + \sum_{n=1}^{5} \beta_n (GR_{nt} \times EW_{cg}) + \sum_{n=1}^{5} \beta^* n (GR_{nt} \times EW_{cg}) \times I_{2013} + \Re K_{it} + \nu S_{it} + \pi_c + \partial ft + \pi_{gt} + e_{icgt}$$

(3)

Equation (3) is similar to Equation (2) but includes interactions of wait-time with both graduation

groups and survey year indicators $(\sum_{n=1}^{5} \beta *_n (GR_{nt} \times EW_{cg}) \times I_{2013})$. Our estimates of the $\beta *_n$'s will allow us to investigate whether differences in the β^n coefficients in equation (2) are due to differences in the effect of wait-time across cohorts or across years since graduation.

By adding these terms we can accomplish two goals: First, we can compare effects of wait-time on the same cohort over time. That is, respondents who were in the group interval 0-2 years in survey year 2010 will move up to group interval 3-5 years in survey year 2013, and so on. This, way we can observe how the effect of wait-time varies with time since graduation for the same cohort. Second, adding graduation group and survey interaction terms will help us to observe if the effect of wait-time for a particular graduation group varies across survey years.

1.6 RESULTS

Table 3 reports demographic characteristics by survey wave for foreign born new doctoral recipients graduating from U.S. universities using the SED data. We see that the average age at the time of graduation is around 33 years. The percentage of males graduating with Ph.D. has declined to 64.6 percent in the year 2010 from 71.1 percent in the year 2000 and 81.9 in the year 1990. The table also

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indicates that more than half of these recent doctoral recipients are married at the time of receiving their doctoral degrees. The average age at the time of entering doctoral program is between 29 to 33 years for these foreign born doctoral recipients.

Table 4 and Table 5 report the distribution of field of doctoral degrees for these foreign born doctoral graduates for selected years. Most popular fields of study among these doctoral recipients are Engineering, Social Sciences, Education and Biological/ Medical. Over the years fields like Engineering, Computer Science and Biological/ Medical are gaining popularity whereas fields like Agriculture, Education and Social Sciences are losing popularity for these foreign-born doctoral recipients.

Table 5 also indicates that most foreign born doctoral recipients (78 percent to 82 percent) in the SED surveys have received their doctorates from high rank schools within the U.S. Further, 55 percent to 62 percent of these doctoral recipients have received their Bachelors' from high ranked schools; among them 85 percent to 93 percent have earned their Bachelors' from their home country that is the country of their birth¹³. The table also presents summary statistics representing quality of these foreign born doctoral recipients. More than 45 percent of these graduates were funded by teaching or research or other types of assistantships as graduate students. A very small fraction had funding from government, private sector or other sources.

Table 6 provides the estimation results from regression equation (1) using SED data. In column (1) we have survey fixed effects, country fixed effects and field of study fixed effects. In column (2) we add all individual and school quality controls, and in column (3) we add the interaction of field of study and survey year. Here we observe that the expected wait-time for acquiring GC status has slight negative impact on the intentions to stay of newly graduated foreign born doctoral graduates. The coefficient on the expected wait-time here is -.011 and is statistically significant at 1% levels. The coefficient indicates

¹³ Source SED-DRF files

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that each additional year of wait-time to acquire GC status will lead to decrease in the probability of intending to stay by 1.1 percentage points. The Jan 2016 predicted wait-times for the immigrants from India and China are 10 and 6 years respectively, which is predicted to decrease the intention to stay percentage of immigrant doctoral graduates from these two countries by 11 and 6 percentage points respectively.

Table 7 is similar to Table 6 but here we restrict our data to immigrants graduating in year 2001 or after. This sample is the universal set of the Integrated SDR sample that will be used to estimate the effects of wait-time on actual retention of the immigrant doctoral recipients from Table 8 onwards. We observe that the coefficient on wait-time increases in magnitude to .015. However, the coefficient is not significantly different from the same coefficient in the Table $(6)^{14}$.

Table 6 and Table 7 show the impact of wait-time on intentions to stay of recent immigrant doctoral recipients. From Table 8 onwards the analysis is focused on impact of wait-time on actual retention (continual stay) of immigrant doctoral recipients. Table 8 examines whether the effect of GC wait-time on actual retention changes with time since Ph.D. attainment. Here, column (1) and column (2) show results of regression specifications (2) and (3) respectively. Column (1) indicates that the impact of GC wait-time is greatest on immigrant doctoral recipients in group 0-2 years since graduation. An additional year of GC wait-time reduces the probability an individual who has graduated in the past two years resides within U.S by 5.5 percentage points.¹⁵ Comparing Table 8 and Table 7, it is clear that the negative impact of GC wait-time is stronger on actual retention (5.5 percentage points) than the stay intensions (1.5 percentage points) for recent immigrant doctoral graduates.

¹⁴ Using T-test for P < .01, .05 and .10

¹⁵ This is significantly different from the same probability experienced by all other older cohorts. This difference is significant using t-test for p <.001

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For immigrants 3-5 years since graduation an additional year of GC wait-time reduces the probability of retention by 1.2 percentage points. We do not observe any significant impact of GC wait-time more than five years after graduation. This suggests that the effect of GC wait-time is short term. Wait-time causes some high skilled immigrants to exit the U.S. sooner than they would have otherwise, but GC wait-time does not affect long term retention. On the other hand, the results in Column (1) may just be cohort-specific in effects. In other words, the coefficients in Column (1) may decrease with time since graduation because earlier cohorts were less responsive to GC wait-time than the most recent cohorts of graduates. In order to determine whether the wait-time effect is short-lived, we need to distinguish between these two interpretations.

In Table 8 column (2) we take advantage of two waves of longitudinal SDR 2010 and 2013 by interacting the indicator for survey year 2013 with the graduation group and GC wait-time interaction term. This way, we can test whether impact of GC wait-time on the same graduation group varies across the survey years. We also observe how the impact of wait-time varies for the same cohort as years since graduation increases. For example, immigrants of group interval 0-2 in 2010 survey will be in the group interval 3-5 in 2013 survey.

The results of equation 5 are reported in Column (2) of Table (8). For the group 0-2 years since graduation there is a small increase in the effect of GC wait-time from 5.1 percentage points to 5.7¹⁶ percentage points between the 2010 and 2013 surveys. For immigrants three or more years post-graduation there is no change in the effect of GC wait-time across the two survey years.

Further, in Table 8 Column (2) the coefficient on interaction term 3-5 X E (WT) X I_{2013} is not significant. This indicates that the impact of GC wait–time for those 0-2 years since graduation in 2010 is

¹⁶ The former 5.1 is the coefficient computed for the 2010 year (Coefficient 0-2 years X E(WT)) the later 5.7 is the coefficient computed for the year 2013 for the cohort (Coefficient 0-2 years X E(WT) + Coefficient 0-2 X E (WT) x I_{2013}).

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not permanent. As this cohort moves to 3-5 years since graduation in survey year 2013, the impact of GC wait-time falls substantially. Similarly, for individuals in the group 3-5 years since graduation in survey year 2010, the slight negative impact of GC wait-time on individual retention (-.009) disappears when they move up to the group 6-8 years since graduation in the survey year 2013. This confirms that this negative impact of GC wait-time on the retention of immigrant doctoral recipients is in fact temporary and it decreases and disappears with time since graduation.

1.7 IMPACT OF MARRIAGE AND EMPLOYER'S UNWILLINGNESS TO SPONSOR GREEN CARD

There are two instances that may impact the estimation of GC wait-time computed in this paper first is marriage to a U.S. citizen or a Green Card holder the second is employers' unwillingness to sponsor Green Card. We cannot observe the exact route or exact GC wait-time for Green Card in the SDR data set. However, using our estimation technique we can compute the closest approximation of the GG wait for these immigrant Ph.D. recipients. There is less chance that this measurement error in computation of wait time strongly impacts the results of this paper.

The immigrant doctoral recipients on spousal Green Card (via marriage) have zero GC wait. This will considerably reduce the GC wait-time for immigrants from China and India. Assuming immigrants on spousal Green Card are more likely to stay within United States because of family bounds. There is a strong chance that ignoring these adjustments for Green Card route might underestimate the impact of GC wait-time on continual stay of immigrants from these countries. With the help of our current analysis we are at least able to capture the lower bound of the impact of GC wait-time on the continual stay for these immigrants.

Employers' unwillingness to sponsor Green Card may add to the GC wait-time for all immigrants irrespective of their country of origin. However, most employees hiring such high skilled employees Note: "The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusion contained in this report."

desire to sponsor GC to add to permanency of the employment. Moreover, immigrants prefer to work with firms with immigrant friendly procedures. There is a less chance that the sample of high skill immigrants is affected by this issue.

1.8 CONCLUSION

The results indicate that an additional year of GC wait-time decreases the probability of retention of fresh immigrant doctoral recipients (0-2 years since graduation) by 5.5 percentage points. The current (Jan 2016) predicted GC wait-times from India and China are ten and six years respectively. This can decrease probability of retention of fresh graduates (0-2 years since graduates) from these two countries by half and one third respectively. However, the results indicate that the impact of GC wait-time on the retention of immigrant Ph.D. recipients is temporary and not persistent. For immigrant doctoral recipients between 3 and 5 years since graduation the impact decreases to 1.2 percentage points, and, for the immigrants at least 6 years past graduation there is no effect of GC wait-time on immigrant's retention in the U.S.

This is the first study evaluating the impact of long waits for Green Card that immigrants from some countries face due to excess demand of residency petitions in the U.S. from their birth country, on their intentions to stay and retention within the U.S. Results of the study can be used to evaluate a bigger policy question regarding the competence of high skilled immigrant policies to ensure retention of the foreign researchers and scientists graduating from U.S. universities.

Note: "The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusion contained in this report."

FIGURES

Figure 1: Impact of GC Wait-Time on the Stay Rates of Immediate Doctoral Graduates from China



Source : DRF – SED Data 1985 -2010





Source : DRF – SED Data 1985 -2010

TABLES

Country of	Number o	f PhD Gradua	ates Receiving	S/E Doctorat	te in the U.S	for Selected
Citizenship	Countries 198	85-2010				
	1985	1990	1995	2000	2005	2010
China	148	1213	621	2098	3388	3557
India	474	724	1210	840	1135	2078
Korea	351	1172	1179	951	1379	1337
Taiwan	717	1006	1299	845	626	616
Canada	234	313	375	396	430	434
Japan	121	154	196	246	256	223
Germany	45	106	210	208	192	188

Table 1 : Number of Ph.D. Graduates Receiving S/E Doctorates in the U.S for Selected Countries,1985-2010

Source : DRF-SED Data1985- 2010

Table 2 : Proportion of 7	Femporary Residents	Receiving S/E	Doctorates,	Intending to	Stay in t	the
U.S after Graduation for	Selected Countries 19	85 - 2011				

Country of	Fiscal year of Doctorate						
citizenship	-						
	1985	1990	1995	2000	2005	2010	
Iran	0.925	0.898	0.788	0.883	0.888	0.877	
India	0.919	0.849	0.869	0.869	0.873	0.845	
China	0.716	0.903	0.93	0.907	0.912	0.839	
Korea	0.603	0.47	0.385	0.562	0.651	0.634	
England	0.789	0.755	0.732	0.598	0.736	0.631	
Taiwan	0.774	0.628	0.451	0.533	0.578	0.603	
Canada	0.457	0.492	0.44	0.588	0.579	0.599	
Hong Kong	0.915	0.821	0.652	0.678	0.782	0.541	
Japan	0.636	0.5	0.392	0.426	0.5	0.488	

Source : DRF – SED Data 1985 -101

	1					
Year	1985	1990	1995	2000	2005	2010
Age	33.635	33.472	33.380	33.540	32.911	32.613
	(5.175)	(5.135)	(5.070)	(5.158)	(4.870)	(4.644)
Gender	.840 (.565)	.819 (.384)	.778 (.415)	.711 (.453)	.685 (.472)	.646 (.478)
Marital Status						
Never Married	0.176	.240	.345	.358	.392	.439
	(.133)	(.427)	(.475)	(.479)	(.488)	(.496)
Married	.526	.618	.553	.561	.542	.509
	(.483)	(.485)	(.421)	(.496)	(.498)	(.499)
Other Status*	.134	.140	.101	.059	.051	.051
	(.345)	(.347)	(.301)	(.237)	(.220)	(.220)
Age at the time of entering	30.541	30.141	30.155	30.076	29.991	30.232
Ph.D. program	(.046)	(.038)	(.047)	(.040)	(.051)	(.045)
Number of observation	5188	8059	8715	9387	12088	12845

Table 3: Demographic Controls SED for Selected Years

Source: SED-DRF Data Files

Notes: Standard errors are clustered at country level and are in parenthesis *other marital status includes divorced or widowed

Year	1985	1990	1995	2000	2005	2010
Field Of Major						
Agriculture (Life Sciences)	.091	.081	.079	.076	.055	.051
	(.015)	(.016)	(.012)	(.012)	(.012)	(.011)
Biological/ Biomedical	.081	.105	.109	.145	.132	.154
	(.013)	(.012)	(.013)	(.013)	(.014)	(.013)
Health Sciences	.018	.020	.028	.030	.029	.029
	(.011)	(.011)	(.012)	(.011)	(.012)	(.011)
Engineering	.271	.281	.286	.254	.281	.294
	(.009)	(.009)	(.010)	(.009)	(.009)	(.010)
Computer and Information	.017	.033	.041	.037	.045	.056
Sciences	(.008)	(.008)	(.008)	(.007)	(.008)	(.008)
Mathematics	.045	.052	.045	.046	.043	.052
	(.007)	(.007)	(.007)	(.007)	(.007)	(.007)
Physical Sciences	.015	.014	.018	.017	.016	.019
	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)
Social Sciences	.120	.105	.106	.101	.098	.093
	(.008)	(.007)	(.007)	(.007)	(.008)	(.007)
Humanities	.041	.044	.064	.065	.059	.046
	(.006)	(.006)	(.006)	(.005)	(.005)	(.005)
Education	.108	.061	.057	.054	.038	.033
	(.010)	(.009)	(.008)	(.007)	(.005)	(.005)
Business Management/	.032	.039	.038	.030	.035	.035
Administration	(.005)	(.005)	(.004)	(.005)	(.005)	(.005)
Communication	.008	.006	.006	.007	.010	.009
	(.003)	(.002)	(.003)	(.003)	(.005)	(.005)
Fields Not Elsewhere	.016	.015	.014	.014	.010	.012
Classified (NEC)	(.003)	(.003)	(.003)	(.003)	(.001)	(.001)

Table 4: Summary Statistics: Field of Major for Selected Years

Source: SED-DRF Data Files

Notes: Standard errors are clustered at country level and are in parenthesis

Year	1985	1990	1995	2000	2005	2010
Graduate School Quality						
(Doctoral Degree) *						
High Rank Schools	.825	.816	.805	.797	.796	.783
	(.005)	(.004)	(.005)	(.004)	(.003)	(.003)
Middle Rank Schools	.170	.178	.188	.196	.200	.212
	(.003)	(.004)	(.004)	(.004)	(.003)	(.003)
Low Rank Schools	.003	.005	.006	.005	.003	.003
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Under Graduate School						
Quality (Bachelors) **						
High Rank Schools	.612	.602	.603	.559	.603	.585
	(.006)	(.006)	(.006)	(.005)	(.005)	(.005)
Middle Rank Schools	.233	.244	.240	.278	.237	.241
	(.005)	(.004)	(.004)	(.004)	(.003)	(.003)
Low Rank Schools	.203	.194	.194	.197	.194	.199
	(.005)	(.004)	(.004)	(.004)	(.003)	(.004)
Individual Quality -Doctoral						
Funding						
No Tuition Remission	NA	NA	NA	.140	.127	.105
				(.003)	(.003)	(.003)
Partial Tuition Remission	NA	NA	NA	.613	.219	.180
				(.004)	(.003)	(.003)
Full Tuition Remission	NA	NA	NA	0	.596	.633
				(.000)	(.004)	(.004)
Scholarship or Fellowship	.076	.054	.054	.162	.201	.198
r r r	(.003)	(.002)	(.004)	(.003)	(.004)	(.004)
Funding TA RA OA	.453	.457	.454	.567	.647	.680
	(.004)	(.005)	(.005)	(.004)	(.004)	(.004)
Funding Government or	.020	.100	.080	.056	.056	.032
Corporate (Non –personal	(.001)	(.003)	(.002)	(.002)	(.002)	(.002)
support)		()				
Other Educational						
Background Variables						
Change in study field after	.484	.502	.504	.546	.478	.505
Bachelors or Masters	(.006)	(.005)	(.005)	(.005)	(.004)	(.004)
	()	((((

Table 5: School Quality, Individual Quality and Educational Background

Source : SED –DRF Files

Notes : Standard errors are clustered at country level and are in parenthesis*For undergraduate school quality I have used the same variable and estimation base as used by Stuen Eric T., Mobarak Ahmed M and Maskus Keith E. (2011) in their publication "Skilled Immigration and Innovation: Evidence From Enrollment Fluctuations in U.S. Doctoral Programs". For more information see **For graduate school

quality I have used National Council's assessments of Research Doctoral Programs 2010. For more information see http://sites.nationalacademics.org/PGA/Resdoc/index.htm

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Table 6: Impact of GC Wait on Intention to Stay in U.S. after graduation, 1990-2013 graduates

	(1)	(2)	(3)
Wait-time	011***	012***	012***
	(.003)	(.003)	(.003)
Survey Fixed Effects	Y	Y	Y
Country Fixed Effects	Y	Y	Y
Field of Study Fixed Effects	Y	Y	Y
Demographic Controls	Y	Y	Y
Individual Quality Control	Ν	Y	Y
Survey Fixed Effects *Field of Study	Ν	Ν	Y
Number of Observation	277565	245171	245171

Source : SED –DRF Files and USCIS

Notes : Here I use Regression Equation (1) and wait-time in years . Sample includes all foreign born doctoral recipients from year 1990-2013 in the SED data.

(Std. Err. adjusted for 228 clusters in country)

*** indicates p < .01. ** indicates p < .05, * indicates p < .10

Table 7: Impact of GC Wait on Intention to Stay in U.S. after graduation, 2001 – 2013 graduates

	(1)	(2)	(3)
Wait-time	015***	016***	014***
	(.004)	(.004)	(.004)
Survey Fixed Effects	Y	Y	Y
Country Fixed Effects	Y	Y	Y
Field of Study Fixed Effects	Y	Y	Y
Demographic Controls	Y	Y	Y
Individual Quality Control	Ν	Y	Y
Survey Fixed Effects *Field of Study	Ν	Ν	Y
Number of Observation	148425	148425	148425
Source : SED – DRF Files and USCIS			

Notes : Here I use Regression Equation (2) and wait-time in years. Sample includes all foreign born doctoral recipients from year 2001-2013 in the SED data.

(Std. Err. adjusted for 228 clusters in country)

*** indicates p < .01. ** indicates p < .05, * indicates p < .10

Table 8: Impact of GC Wait on Retention of Foreign Born Doctoral Recipients Graduating 2001-

2013

	\overline{Y}	(1)	(2)
Wait-time	(Mean Stay)	β _i	β _i
0-2 years X E(WT)	.587	055***	051***
	(.486)	(.009)	(.009)
3-5 years X E(WT)	.581	012***	009**
	(.493)	(.004)	(.004)
6-8 years X E(WT)	.556	009	001
	(.597)	(.006)	(.006)
9-11 years X E(WT)	.547	003	003
	(.496)	(.004)	(.004)
0-2 X E (WT) x I ₂₀₁₃	.579		.006***
	(.437)		(.002)
3-5 X E (WT) x I ₂₀₁₃	.571		002
	(.482)		(.003)
6-8 X E (WT) x I ₂₀₁₃	.557		001
	(.473)		(.003)
9-11 X E (WT) x I ₂₀₁₃	.545		.002
	(.495)		(.004)
Cohort Fixed Effects	Х	Y	Y
Survey Fixed Effects	Х	Y	Y
Country Fixed Effects	Х	Y	Y
Field of Study Fixed Effects	Х	Y	Y
Demographic Controls	Х	Y	Y
Individual Quality Control	Х	Y	Y
Survey Fixed Effects *Field of Study	Х	Y	Y
Cohort * Survey Fixed Effects	Х	Y	Y
· · · · ·			
Number of Observation	14799	14799	14799

Source : Integrated SDR 2010 and 2013

Std. Err. adjusted for 175 clusters in country.

*** indicates p < .01. ** indicates p < .05, * indicates p < .1.

***See Table 9 for Mean Stay Comparisons of China and India with other countries.

****0-2 years, 3-5 years, 6-8 years and 9-11 years are dummy variables. The value is "1" if cohort belongs to the stated interval and "0" otherwise. The interaction term I_{2013} is specific to 2013 survey, if the observation is from 2013 survey it is "1" and "0" otherwise.

Table 9: Cohort-wise Mean Stay for China and India and Not China and India

	Aggregate	Not China	China and
		and India	India
	\overline{Y}	\bar{Y}	\overline{Y}
Wait-time	(Mean Stay)	(Mean Stay)	(Mean Stay)
0-2 years X E(WT)	.587	.506	.668
	(.486)	(.461)	(.423)
3-5 years X E(WT)	.581	.497	.615
	(.493)	(.502)	(.413)
6-8 years X E(WT)	.556	.491	.604
	(.597)	(.442)	(.412)
9-11 years X E(WT)	.547	.487	.598
	(.496)	(.500)	(.374)
Number of Observation	14799	12727	2072

Source : Integrated SDR 2010 and 2013

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