The Economic Loss of not Employing Foreign-Born College Students*

Getano Basso (University of California, Davis)†
Giovanni Peri (University of California, Davis)‡

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Abstract

In this paper we evaluate the employment and wage loss to US states and metropolitan areas from not allowing employment of foreign students on F1 visas and from under-employing college-students who are undocumented. By combining administrative data on student visas and individual American Community Survey data for the cohort of college-attending students in each US state and metropolitan areas in the 2005-2009 period we propose a method to identify the subset of foreign-born college students on F1 visas. We then merge these data with employment data for the same cohort-location in 2010-2014 and we calculate, via a cross-sectional regression, the "transition probability" from college students into local employment for the F1 and the non-F1 foreigners in a state and city. We find strong evidence that F1 students are much less likely to move into employment in the local economy (state, city) relative to foreign students whose likely immigration status allows for work in the US. We then identify the college students in the same cohort who are likely undocumented and we estimate that their transition probability into local employment is lower by 20-30 percentage points vis-a-vis the documented foreign-born students. Some US states may have lost hundreds of million dollars in wage income because of the limited work possibility of F1 and of undocumented college students.

JEL codes: I23, J61, K37, R1

Key Words: Foreign Students, F1 visas, local economies, wage income.

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†Gaetano Basso: Department of Economics, UC Davis, One Shields Avenue, Davis CA, 95616; email: gbasso@ucdavis.edu.

‡Giovanni Peri: Department of Economics, UC Davis, One Shields Avenue, Davis CA, 95616; email: gperi@ucdavis.edu.

1 Introduction

Excluding business trips, visitors and tourists, the largest and fastest growing US visa category in the last 5 years has been the F1 group. This visa category admits students to the US and these are, in large part, college students. Almost 600,000 new F1 visas were issued in 2014 and almost half of them were given to students attending universities or community colleges. Adding exchange student on J1 visas the count reached 930,000 new visas in 2014. This was up from 380,000 F1 visas in 2010. In comparison only 141,000 H1B visas, admitting professional workers to the US, were issued in 2014[1]. While the scale of the students' inflow to the US is already substantial, its impact on the US economy is rather limited. The reason is that the majority of these students, many of whom end up graduating from prestigious private and public universities, have to return to their countries of origin once their degree is complete. The F1 visa does not allow to work and the availability of working visas for foreign-born college educated is very limited. In several instances business leaders, educators and policy makers have emphasized that the legal difficulty in retaining F1 students after graduation is a drain on US-produced human capital. Some have gone as far as claiming that as a consequence of this drain technological growth and innovation may happen in China and India rather than in the US in the future.[2] These students, graduating from US universities become professionals, scientists, engineers, professors with high productivity and they would contribute to US the economy, earn high salaries and pay high taxes. Still, in the current state of things, they mostly leave the city where they attended college and often the US altogether, because of lack of working visa opportunities. A small fraction of them may stay in thee US for graduate studies, another small fraction of them may access H1B or other visas or, even more rarely, permanent employment permits and stay in the US. Most of them, from anecdotal accounts, have to leave the US.

Recently, the department of Homeland Security has proposed to extend the training period after graduation (OPT) for these students and possibly to allow them training and employment up to 6 years after the date of their US college degree.[3] While this is simply a proposal under discussion it has immediately attracted attention and controversy as some people fear a depressing effect on the demand for US college graduates, while other emphasize the beneficial growth effect that it could have on local economies. Retaining foreign students who graduate if they find a job in the US would be a very simple way of translating their human capital into productive ability and into income for the US economy. People who come to the US when young are among the best integrated immigrants as the college years serve as an assimilation period. As the college admission system selects people with strong academic skill their potential income is high.

While the current system allows some of the students on F1 visa to stay in the US if they find a viable visa or permit, in practice only few of them are able to secure a working visa. At the aggregate US level such a loss of human capital can be costly. Even more relevant is that, from a local economy point of view (of a US metropolitan area or a US

[1] These figures are from the Department of State, and they are available at: https://travel.state.gov/content/visas/en/law-and-policy/statistics.html (accessed December 22, 2015).

[2] See for instance "Should foreign Graduates Get a Visa Edge"? New York Times, Oct 27th, 2015.

[3] See " Improving and Expanding Training Opportunities for F-1 Nonimmigrant Students With STEM Degrees and Cap-Gap Relief for All Eligible F-1 Students" in the Federal Register of October 19th, 2015.

state) educating a foreign student may translate in smaller effects on the local economy as those students leave the city or the state. The "local multiplier effect" of a University on the economic output of a city may be reduced if the outflow of these graduates drains the city of a large share of valuable human capital. As the number of foreign students increases in US universities, the ability to retain them in the local economy will affect significantly the economic spillover effects of universities. While usually these students pay their way through tuition fees, and hence may benefit public university that way, their contribution to the growth of the local community would be much larger if they could also work in it, at least for a while.[4]

In this paper we are the first to combine F1 visas from administrative data sources obtained from the electronic system (SEVIS) of the US custom and immigration service (through a Freedom of Information Act request) and the American Community Survey data (from US census) and to estimate, through a regression approach, the transition rate into employment in the local economies (states or metropolitan areas) of F1-foreign college students. In particular, as we merge data at the state-cohort (or metro-area cohort) level we estimate such transition for the cohort of students attending college in the period 2005-2009 and potentially employed after graduation in the period 2010-2014. We device a novel method to identify in the ACS data the students who are likely to be on F1 visas, based on their immigration history and on matching their aggregate numbers with those obtained from the administrative F1 data by state and cohort. Then we compare the transition rates of F1 college graduates into local employment with those of non F1-foreign-born college graduates who we call generation 1.5. They are those foreign-born who immigrated as part of a family, before age 16 and hence, by virtue of their parents status and their longer residence in the US, they are likely to have more legal options to stay in the US. Those non-F1 foreign-born students have adjusted to US life during their school years, they likely still have ties with their country of origin and may not be citizens yet, so they have some similarities with the F1 students. On the other hand some national origins (such as Mexicans, Filipinos and Latin Americans) are much more represented in generation 1.5 than among F1 college students while for other groups the presence of F1-students is as large as (or larger than) the group college-students in the 1.5 generation (e.g. China, Japan, Western Europe).[5]

We construct a cohort of likely F1, and likely non-F1 foreign students attending college in each state (metropolitan area) in the period 2005-2009 and then, following the same age cohort in the state (and metro-area) after graduation in the period 2010-2014, we establish through a regression how strong is the correlation between foreign college students for each group (F1 and non-F1) as share of the considered cohort and the college-educated employees in the same cohort in 2010-2014 period. If all students of one type transition into employment in the same area, then the correlation between the two shares will be one. If no student of one group transition into employment then the correlation will be 0. In general the coefficient of a linear regression of foreign employment share of college educated 25-29 years old in 2010-14 on the share of each type of foreign student attending

[4] Several studies such as Moretti (2004a), Moretti (2004b) emphasize that the share of college educated workers in a city may have positive wage and productivity effects on other workers too. Kantor and Whalle (2014) emphasize the knowledge spillovers from Universities to local economies, part of which is channeled by students.

[5] See in Appendix Table 1, the number of F1 and non-F1 foreigners attending college by nationality.

college and aged 20-24 in 2005-2009 will provide a measure of the rate at which the group move into employment in the same state (or metro area) within four years after graduation. We find that the correlation (transition rate into local employment) is quite high (between 0.8 and 1) for the generation 1.5 of foreign-born. Those students, in the large majority, graduate and find a job in the local economy, contributing to its growth and income. To the contrary the correlation is very low (smaller than 0.1-0.2) for the F1 visa students. These estimates suggest a strong transition from college education to local labor market for foreign-born who are likely to have options to work and a very weak transition probability for those who are likely on F1 visas. While universities contribute to produce the human capital of a large group of foreign students, those with F1 visas are unlikely to enter the local labor market and hence they do not generate the same positive productivity and growth effects after college as other foreign students.

We then look at the group of foreign-born college students likely to be undocumented, also identified based on their immigration history and origin. The transition probability of this group into employment is also somewhat smaller (ten to twenty percentage points) than for the likely documented foreign college students. This could be another instance of human capital drain (or waste) possibly to immigration policy constraints.

These results are aggregate, not causal and they only capture common average tendencies across cities. Using them we then simulate the employment and wage income loss to state economies associated to the lower transition probability of F1 and undocumented college students into employment. Assuming that, if employed, they would obtain the same salary as that of the college educated foreign-born non-F1, we evaluate how much labor income each state lost due to their departure. We show that in some states (Oregon, Massachusetts, Hawaii, Washington) this is a non trivial percentage of new college employment, and in large states (such as California, Texas, New York and Washington) it amounts to hundred of millions of $ in wage income. While we can only speculate that part of the low transition rate into employment is due to the temporary nature of the visa, we emphasize that even a partial retention of foreign college graduates could constitute a substantial wage gain for the local economy.

The rest of the paper is organized as follows. Section 2 describes more carefully the administrative data on F1 students, our way of identifying F1 and undocumented students in the American Community Survey, their distribution and characteristics in the period 2005-2009 and how we merged a cohort-location of foreign college students in 2005-09 to the same cohort-location of college educated workers in 2010-2014. Section 3 analyzes the correlation between college attendance and employment after graduation in the same area (state, metro area) for the cohort of foreign-born students in college during the period 2005-2009. Using a regression framework we estimate how F1 students compare to non-F1 students in their transition rates into local employment. We also analyze the estimated difference in employment transitions from college for the likely undocumented college students and for the likely documented foreign college students. Then in section 4 we calculate the employment and income loss to US metropolitan states, associated with lower transition to employment of college educated individuals who studied on an F1 visa and of the likely undocumented students. Section 5 concludes the paper.

2 Data: Following a Cohort of Foreign-Born F1 and non-F1 students

The data we use are from two main sources. First, through a Freedom of Information Act (FOIA) request we obtained from the USCIS the individual data on approved F1-visas between 2003 and 2009, this is the base to count the F1-college students in the US between 2005 and 2009. Then from the American community survey (ACS) we used data on foreign-born non citizens age 20-24 attending college programs in the period 2005-2009 and we followed those same cohort as 25-29 years old college graduates in 2010-2014. The USCIS is an administrative database and it lists the school, location, program enrolled in the US, country and city of origin of each foreign student who received an F1 visa between 2001 and 2009. Among those we selected only the students attending bachelor or associate degrees in US colleges (excluding lower education, and language courses as well as graduate programs) and we focussed the attention to the period 2005-2009, during which the fully computerizes SEVIS system was keeping track of every single foreign student on an F1 visa, while in the US.[6] We call these F1-college students. In order to translate these visas into presence of foreign student we assumed that each student was in the recorded university for the whole length of the program he applied for. This may imply that if some F1 students dropped out of their program (a relatively rare occurrence) we are over-counting their number. From this dataset we construct the count of F1 students attending college in 2005-2009 in each US state.

The first column of Table 1 shows the total count of F1 students obtained for each year between 2005 and 2009 following the definition given above, from the USCIS administrative database. Their number grew from 255,000 in 2005/06 to more than 308,000 in 2009/10. The same Table 1 shows, in columns 2 and 3, the counts of college students on F1 visas from different sources that also report the total number in 2005/06 up to 2009/10. The first is based on a survey conducted yearly by the International Institute of Education that focuses on the international component of US universities. The second is from a census conducted by the National Center for Education Statistics. The figures, while not identical, are similar to those from USCIS and they strengthen our confidence in the administrative data and in our calculations. Our administrative data seem to capture fairly well the number of college-attending students on F1 visas in the US.

2.1 Matching a Cohort of F1 students in USCIS and in ACS Data

We then turn to constructing the cohort of foreign-born college-attending students from the ACS. In this case we do not have any indication of their visa status. Hence we start by selecting all foreign-born non-citizens in the 20-24 age range who are attending a 2 or a 4 year college in the period 2005-2009. These are certainly foreign students in US colleges, but which ones are on F1 visas, as opposed to being in a more permanent immigrant

[6] The system was put in place after 2001, but before it became fully efficient and operational and covered all the student population few years were needed. See Shih (2015) for an account of the SEVIS system.

situation (parents' visa, permanent residents, family visas) is not known. In order to identify among them the individuals with highest probability of being on an F1 visa we select those arrived in the US at 16 years old or later and who are not dependents/spouses in a household with a different head of household. As F1 college students usually come in the US around college age and by themselves or as head of household these criteria should select people with high probability of being F1. In order to validate our choice we do two things. First we check that the aggregate number produced by this selection is not too far from the number obtained by the F1 administrative data for the whole US. Although some students in our group may certainly have other type of visas, we want to select a group whose size is not too different from that of F1 visa students as provided by our administrative data. Second, as we can calculate from the ACS the distribution of these "imputed" F1 students across states we also check how that the distribution of the corresponding F1 students from the SEVIS (USCIS) data acrosss States is similar to that of our ACS imputed F1 students.

The last column of Table 1 shows the number of imputed F1 from the ACS. We see that the number of imputed ACS-F1 is growing over time and it is 15-20% larger than the other figures (from administrative data). While certainly our method includes some non-F1 students, the ACS aggregate value is not too far from that obtained from administrative source. More informative and even more relevant is the correspondence between ACS-F1 and SEVIS-F1 across US states, as it provides an important check of the correlation of these values across satates. This is represented in Figure 1, for all US states, and in Figure 2, for the US states excluding the four largest so as to show better the distribution of the non-top states, which are otherwise relegated to a corner of the chart. If the count of F1 college students were exactly the same from either source, then the point corresponding to each US state would be exactly on the 45 degree line of Figure 1 and 2. Deviations from the 45 degree line imply the existence of error in measuring F1 visa students in the ACS sample. The figures show that all US states line up not far from the 45 degree line and that some states are above and some below it. This implies that our method has some error, but that the error is not systematic in one direction (over or under measuring the F1 students) and that the error is not too large (most deviations are between 5 and 10%). These two checks are a good validation that our procedure is likely to identify, with some error, the F1 students attending college between 2005 and 2009 in the US.

As a consequence of our procedure that identifies F1 students in the ACS, we also identify the complementary group of foreign-born, non citizens, *who are not on an F1.* In our definition they arrived in the US before the age of 16 and could be in a household as dependents. They can be called "generation 1.5" as they arrived with their parents and they likely benefit from more permanent immigration status relative to the F1. In this paper we consider them as an interesting reference group for the trends of the F1 students. Certainly, this group might resemble native students and workers more than F1 students in several aspects. However, their likely more permanent immigration status would be an important reason for them to show higher probability of transition into local employment, relative to their F1 peers. For the moment we consider all non-F1 college students in this group. We will separate in the next section, a subgroup that has high probability of being undocumented and we will analyze their presence and probability of transition into local employment.

2.2 Numbers, Distribution and Correlations for F1 and non-F1 Foreign Students

College students identified as likely to have an F1 visa constituted about 2% of the US college population in the considered period (2005-2009) and cohort (20-24 years old) and they have been growing since then. A high percentage of F1 college students is found in several West Coast states (Oregon, Washington, Hawaii) plus some East Coast states with important college institutions (New York, Rhode Island, Maryland). Figure 3 Panel A shows the states with largest percentages of F1 among college students in the cohort of 20-24 years old (2005-2009). Their percentages range between 2.5 and 4.5 points. The US states with lowest percentage of F1 among college students, shown in Panel B of Figure 3, are instead mainly in the South and in the Mountains of the United States and count less than 1% of these students. To have an idea of the geographic distribution of F1 students as percentage of college attending population Figure 4 shows a map of the 48 contiguous US states and the larger percentage of F1 students is represented with darker colors. We see that some of the states with the larger presence of F1 are also states attracting many immigrants (California, New York), but some other states with smaller foreign population seems to have the lead in attracting F1 students (Oregon, Washington, Rhode Island). In part, the proximity to Asia, largest source of F1 students, and the presence of large number of colleges (which is true for the Pacific northwest states) may drive part of this pattern. Even more informative is to look at the metropolitan areas that have the largest share of F1 college students. The top 15 metropolitan areas are shown in Figure 5. Several metropolitan areas with very reputable and prestigious universities (Boston, San Francisco, Ann Arbor, Eugene) are among the cities attracting a very large share of F1. Very highly ranked public universities (such as university of Washington, University of Michigan, University of Wisconsin, University of Oregon, University of Illinois) and private universities (Purdue, Brigham Young University, New York University) are among those with largest number of F1 students (see Table A2 in the Appendix for the top US schools in terms of H1B visas). This suggests that many F1 students are high achieving and highly academically motivated.

It is also interesting to compare the presence of the F1 students with the presence of other foreign college students, from generation 1.5. Those likely came with their family and their presence is likely to be large in high immigration states. Their presence is somewhat correlated with the presence of F1 students but not too strongly, showing that the driving forces of these two phenomena are likely not the same. Traditional immigration states, such as California, Florida, New York and New Jersey have a large foreign college population that is likely not F1, but rather from children of immigrants, generation 1.5. On the other hand some states attracting a large share of F1 (such as Hawaii, Washington and Oregon) do not have as many foreign college students from generation 1.5 of immigrants. The correlation between the share of these two types of foreign college students is shown in Figure 6 (linear correlation coefficient is equal to 0.1 and the standard error is 0.045). The map showing the distribution of non-F1 foreign students as percentage of college students in US states is shown in Figure A1 of the appendix. It shows a pattern more similar to that of overall immigration into US states rather than to the F1 distribution. California, Florida, New York and New Jersey are the states with largest presence of these foreign college students.

2.3 The "Likely" Undocumented Foreign-Born College Students

So far we have identified all the likely non-F1 non-citizen students in the ACS as one group, and we have implied in our discussion that they may have a more permanent immigration status vis-a-vis the F1 students. Here we want to isolate another special group who may also be at a disadvantage because of its immigration status and, as a consequence of that, it may have a lower probability of transition from college into local employment. This is the group of undocumented foreign college students. They are those who entered the US as undocumented young children with their family and attended college in the US as 20-24 years old. While several college institutions have allowed them to obtain an education, and several states (see for instance Kaushal 2008 or Amuedo-Dorantes and Sparber 2014) have allowed them "in-state" tuition status and access to financial aid, these students may face challenges when they try to find a job as they do not have proper documentation. At that stage they may remain unemployed for long periods, or try to move where some opportunities exist and some of them even consider returning to Mexico or Central America. This is the group often called of "dreamers" from the DREAM Act (Development, Relief, and Education for Alien Minors) that several time has been proposed as legislative action to grant legal status to young undocumented who attend college. Such proposals have never become law. In the ACS data we identify those individuals who are more likely to be part of such undocumented group. We do this by choosing those born in Mexico, or in Latin America, who arrived in the US between birth and age 10, and are not head of household and are not US citizen. The choice is driven by the fact that some of these students are still part of their parents' or of an extended household while attending college and our choice identifies the countries of origin (Mexico and Latin America) and the period (1985-1995) that maximizes the probability of being undocumented. Moreover, as the selected individuals have been in the US for at least 10 years, the fact that they are still not citizens make their undocumented status even more likely. This definition is in line with what done by Kaushal (2008) and Amuedo-Dorantes and Sparber (2014) when identifying undocumented college students. The vast majority of undocumented "dreamers" is certainly part of the selected group. However a fraction of this group may not be undocumented. We will define them as "likely undocumented".

During the considered period of college attendance (2005-2009) the group of "likely undocumented" among college students age 20-24 was quite sizeable in several states. In California, Texas, Florida, New Jersey and New York the group was larger or similar in size than the group of F1 foreign students. Overall, however, it represented a smaller fraction of the college population relative to the F1 students. For these students, college education may be less effective as a entry-way to successful employment and career. While some features of their disadvantaged background can be an issue for employment transition after college (poorer family of origin, less than perfect language skills), certainly lacking regular immigration status can be the biggest hurdle to effective employment for this group. We are not aware of any systematic study that compares the transition into the local labor markets of thesecollege students relative to other, similar but documented, foreign college graduates. As their potentially lower probability of employment is a result, in part, of their immigration status, we are the first to try to quantify in this paper how many jobs and how much employment income is associated to the current situation relative to a situation in which they could find employment in the local economy at the same rate as

other documented, foreign college educated individuals.

Figure 7 shows the presence of F1 students (green bars), non-F1 documented students (blue bars) and likely undocumented students (orange bars) as percentage of the college population, in several US states. We report those states with largest share of foreign college students (in the left panel) and those with the smallest percentage of foreign born (in the right Panel). In California, Texas, Florida and New York the likely undocumented college students are a very significant group, that is often larger than the F1, reaching a total of about 2% of the group.[7] In other states they represent a much smaller fraction of foreign college students.

3 Employment Transition of Foreign-Born students

3.1 Empirical Framework

We now analyze the probability of transition from attending college into graduating and being employed for foreign students of each type (F1, non-F1, and then the likely undocumented) across states and metropolitan areas. We focus on the cohort that attended college in the period 2005-2009 and was in the age range from 20 to 24 in that period. As we cannot follow single individuals in the ACS, we consider the whole cohort in each state (or metropolitan area) first in 2005-2009 as college students and then in 2010-2014 as possible employees. Once these individuals graduate from college and find a job their household structure changes relative to when they were students and hence we cannot observe some of the features that allowed us to identify them as likely F1 while students. Hence, in the ACS data we observe the aggregate size of this cohort of foreign-born in each state (or city) in the period 2010-2014 and we observe if they have a college degree and if they are employed. We then use this information across metropolitan areas and states, together with the measure of each group when they were college student in 2005-2009 to estimate, via a simple cross-sectional regression, the average transition rate to local employment (within the state or metro area). To do this we run the following regressions crosss sectional regression across units i that represent, alternatively, states or metropolitan areas:

$$\left(\frac{Empl^{Coll,25-29,Foreign}}{Empl^{Coll,25-29}}\right)_{2010-14,i} = \alpha + \beta_{F1}\left(\frac{Stud^{Coll,20-24,F1}}{Stud^{Coll,20-24}}\right)_{2005-09,i} + \beta_{non-F1}\left(\frac{Stud^{Coll,20-24,foreign\ non-F1}}{Stud^{Coll,20-24}}\right)_{2005-09,i} + \varepsilon_i \quad (1)$$

This regression estimates the linear correlation between F1, non-F1 foreign students as share of the cohort of 20-24 years old who attended college in a specific state or metro

[7] Notice that there are very few measures of the population of undocumented college students across US states. A reassuring statistics shows that for Texas in 2013 about 1.9% of the college attending population is estimated to be undocumented, which is a value very close to our figure for Texas shown in Panel A of Figure 7 (http://www.texastribune.org/2015/04/16/colleges-undocumented-students-with-state-tuition/).

area i, respectively $\left(\frac{Stud^{Coll,20-24,F1}}{Stud^{Coll,20-24}}\right)_{2005-09,i}$ and $\left(\frac{Stud^{Coll,20-24,foreign\ non-F1}}{Stud^{Coll,20-24}}\right)_{2005-09,i}$, and the employment of the same cohort as share of total college educated in the state (metro area) five years later (once they have likely graduated) $\left(\frac{Empl^{Coll,24-29,Foreign}}{Empl9}\right)_{2010-14,i}$. If foreign students of each type, transition into graduation and employment within the area with the same probability as the average (native) student then their share in total employment will mirror exactly their share in the college student population and hence $\beta_{F1} = \beta_{non-F1} = 1$. The sum of foreign-born (F1 and non-F1) as share of college students will equal, with an error, to the sum of foreign-born as share of college-educated employed four years later. To the contrary if no foreign student moved into employment (as they dropped out of college or left the local economy) then $\beta_{F1} = \beta_{non-F1} = 0$. Hence, the coefficient β_{F1} capturing the correlation (co-movement) of F1 students and foreign college-educated employees five years later can be interpreted as the average rate of foreign F1 students moving into local employment and β_{non-F1} is the average rate of non-F1 foreign students moving into local employment. Both rates are standardized to the average transition into employment of average college educated in the cohort which is essentially (as they are about 95% of all students) the rate of transition for the native college cohort. The term ε_i captures a classical zero-average measurement error.

A second specification that we estimate separates the non-F1 foreign students between those who are likely to be undocumented and those who are not. In this case we split the second term on the right hand side of equation (1) into two terms as follows.

$$\begin{aligned}\left(\frac{Empl^{Coll,25-29,Foreign}}{Empl^{Coll,25-29}}\right)_{2010-14,i} = \alpha + \beta_{F1}\left(\frac{Stud^{Coll,20-24,F1}}{Stud^{Coll,20-24}}\right)_{2005-09,i} + \\ +\beta_{doc-non-F1}\left(\frac{Stud^{Coll,20-24,doc\text{-}non-F1}}{Stud^{Coll,20-24}}\right)_{2005-09,i} + \\ +\beta_{undoc}\left(\frac{Stud^{Coll,20-24,foreign,undoc\text{-}non-F1}}{Stud^{Coll,24-28}}\right)_{2005-09,i} + \varepsilon_i\end{aligned} \tag{2}$$

In this case the coefficient $\beta_{doc-non-F1}$ represents the probability of non-F1, likely documented, college students to move into local employment, while β_{undoc} captures the probability for likely undocumented college students. This simple framework allows us to use variation in the presence of these three groups of foreign students attending college across states or metropolitan areas and the corresponding variation of foreign-college educated in employment of the same cohort to estimate a rate (probability) of 4-year transition of each group into employment. As the presence of these three types of foreign students varies substantially across states, with some states having many F1 college students, but not many undocumented, and vice-versa the cross-sectional variation is enough to identify such transition probability.

Several caveats are in order. First, the estimated coefficients are transition rates for the whole cohort and they are estimated on a cross section of states or cities. To interpret them as "individual probablity" of transition one has to think that there is a representative agent in the cohort. Second we cannot really pinpoint what the reasons for their difference are. We have identified three groups likely to have different immigration

status, and we will speculate that those differences may be an important determinant of the differential coefficients, but we cannot rule out other explanations due to differences in characteristics as we have not an effective way of establishing causation. Third, as we do not have individual data, we only estimate aggregate net effects not individual probabilities. There may be a much larger gross flows of foreign students across areas, and hence each individual may have a larger probability of moving out (and outsiders may be moving in), but we only capture an aggregate net effect. Fourth the cohort we are considering is one that experienced a deep recession close to the time of college graduation (2008-09). This recession may have affected their initial employment chances. This may imply that the transition from college to employment was particularly hard in this period for all newly graduated individuals. In this situation F1-students and likely undocumented may have been more strongly penalized in the labor market. Our analysis accounts for different transition probabilities into employment across states and in the specific period as it standardizes for the overall number of natives moving into employment (in the denominator). Still, the more vulnerable groups of F1 and undocumented foreign students may have been penalized further. The more recent cohort, attending college in 2010-14 and entering the labor market this year and in the next years, may have somewhat better economic perspectives, as entering the labor market in a perif of recession may have long-term negative characteristics (see Oreopulos et al 2012). However, bar some legislative action, in terms of immigration status and potential access to work permits, these recent cohorts do not differ at all from the one considered here.

3.2 College-local employment transition of F1 and non-F1

Table 2 and 3 show the estimated transition coefficients for F1 and for non-F1 foreign students in the age range 20-24 during the years 2005-2009, obtained from equation (1). Table 2 shows the estimates using 50 states plus DC as units of analysis while Table 3 considers 227 metropolitan areas as units plus 50 non-urban units, one for each state, so that thiss dataset also covers the whole US[8] In Table 2, column (1) is the baseline specification estimated using OLS and reporting heteroskedasticity robust standard errors. Column (2) excludes California from the regression, as this is the largest state in size and in number of F1 students and it is somewhat of an outlier. Column (3) implements our preferred specification, as it weights each observation for the size of the considered cohort in the state. This method gives more weight to larger states and it accounts for the lower precision of measures in smaller units. Overall the coefficients are stable across specifications and they reveal a very striking difference between row 1 (the estimates of β_{F1}) and row 2 (the estimates of β_{non-F1}) . The estimated "transition rate" into local employment for F1-college students was essentially 0, while that rate is estimated between 0.87 and 0.92 for non-F1 foreign-born college students. The standard error is large enough that we cannot reject small transition rates in the order of 0.1 or 0.2 for F1 students, but certainly the aggregate data reveal an extremely low correlation between the presence of F1 students and employment of foreign born in the same cohort five years later (in 2010-2014).

[8] In the ACS 2005-2014 we can consistently identify 227 metropolitan areas. We define additional 50 metropolitan areas, one for each state, by pooling the observations that do not belong to a consistently-defined metropolitan areas in the sample period.

Instead, foreign-born students with more stable immigration perspectives moved into local employment at similar rate as natives (coefficient not significantly different from 1). If their immigration status is responsible for part of this difference then states with large F1 population may have a substantial loss of potential college graduate workers,educated in local universities, because their visas do not allow them authorization for jobs.

Table 3 shows the same estimates considering metropolitan areas as units of analysis. The specifications in this table show a baseline regression (1), obtained using OLS and all 277 metro area. Specification (2), then, includes only the largest (and more precisely estimated) one hundred Metropolitan areas and specification (3) weights each observation for the size of the student cohort in the metro area and is our prefereed specification. The coefficients are consistent with those estimated across states. The "transition rate" for foreign non-F1 is in the range 0.60-0.88, a bit smaller than when estimated across states, but comparable. It is reasonable that metro areas experience larger loss of some foreign students who transition to employment in other areas, relative to states that are larger economies. However, the transition coefficient is still not far from 1, revealing that foreign non-F1 students transition into local employment within a metropolitan areas with similar probability as natives. To the contrary, even at the metro area level the transition rate to local employment for F1-students is never significantly different from 0 and always small, with a point estimate between 0 and 0.1. Metropolitan areas and state economies do not internalize the benefits in terms of employment, productivity and income from the F1 students who study there. The local economy employs at most one or two f1 college students out of every ten who are schooled in local universities. This is not due to the fact that they are foreign-born, as the group of foreign students likely to have more permanent immigration status transition into local employment at the same rate as natives and equal to 8-9 workers per 10 college students. Such small college-employment transition rate may be due to their ties with the country of origin, to their higher propensity to mobility but, at least in part, it could be due to the fact that F1 students have extremely limited legal options to obtain a job in the US. As these individuals are college educated, talented and likely well integrated by the time they finish college, the possibility of loosing most (or almost all) of them because of immigrant visa reasons seems a policy that need some serious thoughts.

3.3 College-Local Employment transition of likely undocumented students

In Table 4 and 5 we extend our analysis by splitting the group of non-F1 foreign students into a part of likely undocumented and a part of likely documented students. In this case the definition of "likely undocumented", as described in section 2.3 is based on the time and country of arrival, chosen as to maximize the probability of them being undocumented. In these tables we estimate specification (2) described in section 3.1 and we obtain for each of the three groups of foreign students (F1, non-F1 and likely undocumented) the transition rate from college into local employment. Table 4 performs the analysis across states estimating a baseline (1) a weighted specification (2), one excluding California (3), one including region fixed effects (4) and one including Census division fixed effects (5). These last two specifications allow for some region- or division-specific trends in how a

foreign college cohort translates into the employment shares of college educated. The coefficients in the first row confirm the very low values, not significantly different from 0, of employment transition rates for F1 students. Those in the second row confirm that for non-F1, likely documented, foreign-born the transition rate is much higher and usually close to 1. As for the likely undocumented, especially focussing on the preferred weighted regressions, the transition rate is usually somewhat smaller than for the documented group. The rate is around 0.8 denoting a lower rate of transition into employment of undocumented college students by 10 to 15 percentage points[9]. Table 5, estimated across metropolitan areas, suggests even more clearly the trends described above. First F1 students show a transition rate into local employment between 0 and 0.14 confirming the low tendency of metropolitan economies to employ these locally trained college students. The non-F1 foreign born, instead move into local employment at a rate between 0.6 and 0.9 for the group of likely documented non-F1 students. The likely undocumented students, finally, transition from college to local employment at a rate that is usually between 0.55 and 0.75.[10] Even in this case the transition rate from College to employment is 10 to 20 percentage points lower for undocumented relative to documented and it is fully 60 to 70 percentage points lower for F1 than for documented non-F1 students.

The standard errors for the estimated coefficients are large enough that it is usually not possible to rule out an equal transition rate of likely documented and likely undocumented students. However, the point estimates suggest a gap for the likely undocumented in the rate of transition into employment for the considered cohort. Legal status may not be the only factor affecting their transition to employment. Our criterion may select students from disadvantaged family of origin and this may also have a role. However, let us remind the reader that the sample considered includes only college attending undocumented people who therefore, have already overcome substantial limitations and are motivated and committed to schooling. Certainly, for this group, being undocumented can be (and in many anecdotal stories is) a very relevant hurdle in the transition to the labor market. In this approach and with our available data we can quantify, albeit imprecisely, the aggregate gap for this group in the transition probability to employment. While we only estimate an effect on employment it may also be that the undocumented status affects these individuals by downgrading their occupation and being associated to other forms of under-employment. More detailed individual data-sets may enable researcher to estimate those effects as well.

With these estimates of the average rate of college to employment transition of foreign students with different immigration status we are ready to evaluate the potential loss of employment for the considered cohort in each state and we can calculate the dollar amount foregone in wage income, associated to lower employment transition probabilities of the F1 and undocumented college students, for all US states.

[9] In the case of weighted regression without California the transition rate of undocumented is the same as the rate of documented. This may reveal a particulalry low transition rate to employment of undocumented in California.

[10] Specification (1) of Table 5 shows the baseline estimation, specification (2) is weighted by the size of the cohort, specification (3) only includes the 100 largest metro areas, specification (4), (5) and (6) include respectively region, division and state fixed effects. Specification (7) calculates standard errors clustered by state.

4 Wage and Employment losses in States

A first simple quantification of the "human capital" loss from F1 college graduates leaving the country is represented in Table 6. This table shows how many F1 college graduates did not move into employment, as share of the college educated cohorts aged 25-29 in 2010-2014, in the top 10 states in terms of F1 presence. Between 2.2 and 4.2 percent of the cohort of newly college graduates was lost to the local economy, and did not translate into employment, because of the lower transition rates of F1 students relative to other foreign-born into employment. The values are calculated as the difference between the estimated transitions rate of F1 students and of non-F1 students from column (3) of Table 2 (the transition rate for F1 being rounded to 0) and applying this difference to the share of F1 students in the college student group between 20 and 24 years of age (2005-2009) in the state. States with large population of F1 students (relative to the total) had a larger percentage loss. The "counter-factual" scenario is a situation in which the transition into local employment of F1 students would be the same as for non F1 foreign students. Hence, the calculated loss is with respect to that alternative. States like Hawaii, Oregon, Massachusetts and Washington lost between 2.2 and 4.2 percent of their cohort of college graduates. These states had slower growth of college-educated workers every year, in part because they were not allowed to retain the foreign-born (F1) students that they had schooled. While we want to emphasize once more that the immigration status need not be the only determinant of this difference, so that allowing F1 students to access working permit in the US may not translate fully in an employment transition probability equal to that of non-F1 foreigners, the results are striking enough to suggest (and the anecdotal evidence confirms it) that the F1 status may be responsible for at least part of this difference.

A similar exercise can be performed in order to calculate the loss from lower transition into local employment of likely undocumented foreign student. In this case we evaluate the loss of employment to the cohort of college students 2005-2009 deriving from the difference in transition rates between the likely undocumented and the documented. We use the difference in those coefficients as estimated in column (2) of Table 4 and we apply it to the share of likely undocumented in the college student group of 20-24 years old, by state. Table 7 shows the college-graduate employment loss as share of the employment of the 25-29 college graduate cohort in 2010-2014 for the top 10 US states. As the group of likely undocumented college students is smaller than the F1 group and as the employment transition loss is also smaller for this group, the losses are in the order of 0.1 to 0.4 percentage points of the cohort of newly college educated in 2010-2015. This number is one order of magnitude smaller than that capturing the loss of F1 students. California, Texas, Florida and New York are the states experiencing the largest losses because of the low employment transition rates of undocumented affect a larger group of college students.

Let us qualify our "calculations" a bit more. In producing the estimated employment losses we have assumed that the lost F1 and undocumented college educated employment is not replaced by employment of native college educated workers. This is quite plausible as several studies (e.g. Peri, Shih and Sparber 2015, Peri and Sparber 2011) show that there is no displacement between immigrants and natives, especially highly educated. In fact, several studies (e.g. Moretti 2004a and 2004b) suggest that the loss of college

graduates may have a negative external impact on wages of other workers. This would further increase the negative wage impact of loosing foreig college educated people. We have also generated a counter-factual in which F1 and undocumented have the same transition probability to employment as documented foreign-born. We cannot establish, howvere, that this can be achieved by giving those groups similar immigration status as that of generation 1.5 of non-citizen immigrants. Our estimates are only correlations. Finally we are assuming that we can learn a general lesson from studying in detail the generation of college students that attended college in 2005-2009 and joined the labor market in 2010-2014. This is the more recent group that we can observe in college and in the labor market.

Table 8 and 9, translate the employment losses (from F1 and undocumented lower transition probability) into income losses for the states (top 10 in terms of dollar losses) by evaluating each job lost by an F1 (Table 8) and an undocumented (Table 9) at the average yearly wage (in 2013 US $) for a foreign-born college educated in the same cohort of 25-29 years of age, in 2010-2014. This is a simplistic way of calculating the aggregate income losses, but it certainly captures the bulk of such losses assuming that the F1 and undocumented would have similar productivity as other foreign-born workers of similar age and education. Table 8 shows that a state such as California, that is home to the largest number of F1 and undocumented population of college students (in overall numbers) foregoes more than 1.8 billion $ from not employing F1 graduates and almost another 0.5 billion by under-employing the undocumented college graduates. New York gives up 1.4 billion of wage income and Texas close to 800 million also due to loss of F1 potential workers. The under-employment of young, likely undocumented college graduates also costs some large states a significant amount of wage income. New York states loses close to 170 Million $, Texas close to 100 Million and Illinois almost 50 Millions $. While the large size of those states makes this a small percentage loss, we can see how there are very significant aggregate income losses, and consequent tax, production and local consumption losses from not allowing in the labor market the two categories of foreign-students analyzed in this paper. Considering that the population of these F1 students is growing fast these figure can become even more substantial in the near future.

5 Conclusions

While many recent studies on the future of high skilled jobs in the US have concentrated on the H1B visa program as a channel for foreign skilled workers to enter and contribute to the US economy, there is another large and, we think, more interesting opportunity constituted by the many US-educated, high achieving foreign students who are becoming a growing part of the college population in the US. They are usually admitted to very good US colleges, they adjust to the US culture and perfect their knowledge of the language while students and, when graduating, they could become highly productive, high earning and well adjusted US workers. We know very little, however, on how many of those are retained by the US, and by the states and local economies where they studied. We do not know anything on how large is the income loss to local economies associated to their return to their country of origin. Next to them there is also another group of foreign-born college students whose ability to create income and to become workers, once graduated, may be

hurt by their unusual immigration status. They are the undocumented students (mostly Mexican) who came in the US with their family as children of undocumented immigrants and are still facing the perspective of graduating and not having proper authorization to work in jobs that are in line with their qualifications. In this paper we develop, for the first time, a methodology to follow a cohort of foreign-born college students (who were 20-24 years old in the period 2005-2009 and moved to employment in 2000-2014) and to identify among them those likely to be on an F1 visa, the foreign born likely to have legal immigration statsu and the likely undocumented. By combining ACS data, administrative data on F1 students and our knowledge of the legal restriction for being an F1 student we separate the three groups and validate our choice. Using state and metropolitan area aggregates we estimated the transition frequency from college to employment for foreign students and for the F1 and the undocumented among them. The results, based on simple aggregate annd cross sectional regressions, suggest a much lower transition rate to local employment of F1 students and a somewhat lower employment probability of undocumented relative to foreign-born who have more permanent immigration status. This paper is only the beginning of this line of research and it suggests that there may be very large returns to US states and cities who educated those students, in terms of local employment and income, if these two type of students (F1 and undocumented) were allowed to have work authorization in the US. More research and further analysis, using individual data and following several different cohorts is needed. In particular we are in the process of exploring the impact of policy changes that may have affected the probability of transition to employment of each of these groups. Two interesting examples are OPT and DACA. The introduction of Optional Practical Training (OPT) for STEM college graduates in 2008 allowed foreign college students to stay in a US job for up to 29 months after graduation. The introduction of Deferred Action for Childhood Arrival (DACA) in 2012, was a measure that guarantees protection against deportation (if not legal status) for the group of undocumented who arrived as children. These measures might have improved the chances of transition to employment for F1 and for undocumented students, respectively. We hope to develop a more causal analysis following these policies and we also hope that this line of research inspires more people to focus on the potential economic consequences of allowing work permits to foreign students. This will help quantifying the cost of restrictive immigration policies that reduce the employment opportunities in the US of a very desirable group: the smart, motivated and young foreign college graduates.

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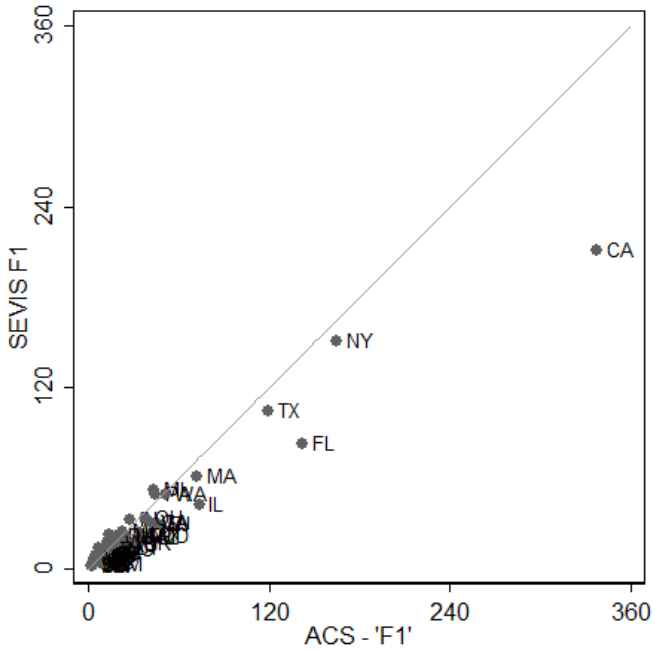
Tables and Figures

Table 1: Total number of likely F1 college students in the US, from different sources, 2005-2010

Source:	**F1, USCIS Data**	**Open Doors Data**	**IPEDS data**	**American community survey**
Year	*F1 attending bachelor and Associate degrees*	*F1 Undergraduates*	*Non-resident alien undergraduates*	*Our match for 'F1' in ACS*
2005/06	255,111	236,342	255,095	339,694
2006/07	266,524	238,050	259,471	354,205
2007/08	275,726	243,360	271,842	365,244
2008/09	290,436	269,874	293,948	341,903
2009/10	308,858	274,431	306,194	355,175

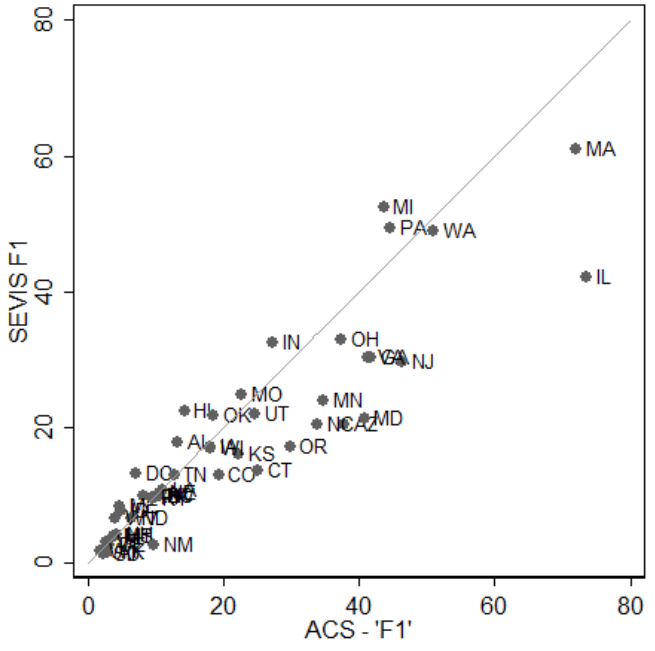
Note: F1 USCIS data are obtained from the F1 data, selecting college students enrolled in bachelor and Associate degrees. Open Doors (International Institute of Education) data obtained at http://www.iie.org/en/Research-and-Publications/Open-Doors/Data/International-Students/Academic-Level/1954-2010 (last accessed in September 2015). IPEDS data are from the September Survey (National Center for Education Statistics): courtesy of Kevin Shih. The American community Survey data (ACS) are our elaborations using the individual census data.

Figure 1:
Correspondence in the count of SEVIS-F1 college students and ACS-F1 college students
US States, Pooled numbers, 2005-2009



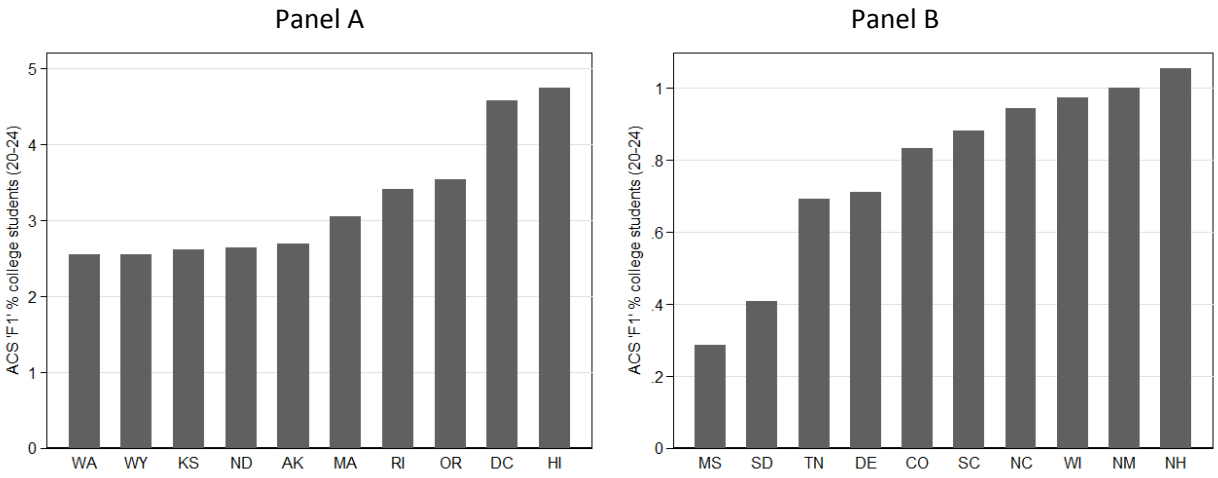
Note: Count of students attending college with an F1 visa. Vertical axis shows data from SEVIS. The horizontal axis shows imputation from ACS.

Figure 2:
Correspondence in the count of SEVIS-F1 college students and ACS-F1 college students
US States, excluding California, New York, Texas and Florida; Pooled numbers, 2005-2009



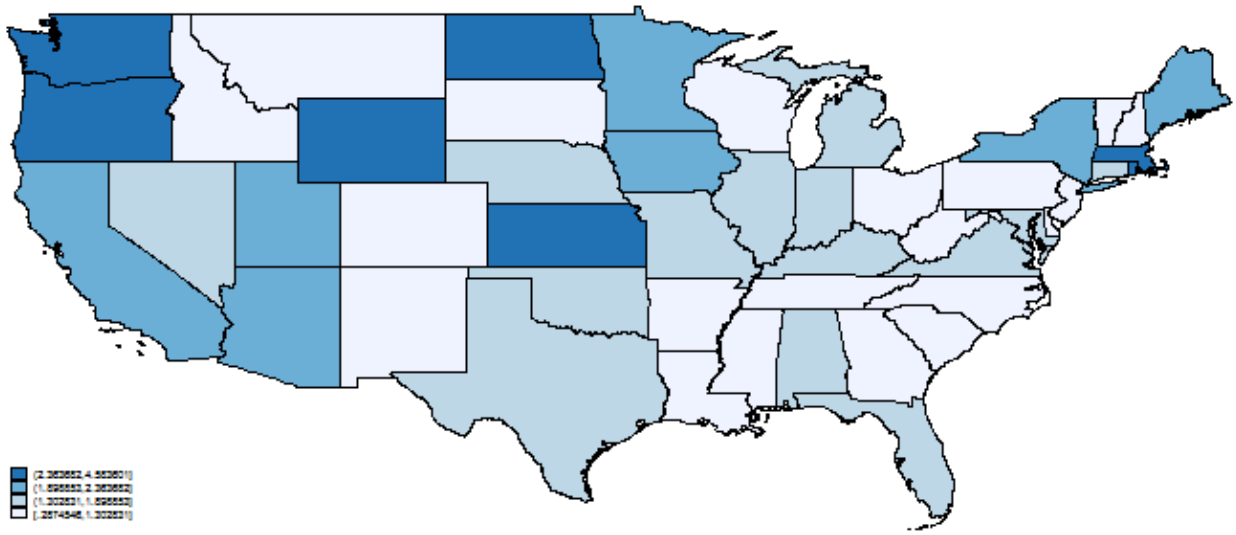
Note: Count of students attending college with an F1 visa. Vertical axis shows data from SEVIS. The horizontal axis shows imputation from ACS.

Figure 3
US states with highest and lowest number of F1 visas as percentage of 20-24 years old college students



Note: The chart shows the 10 states with the largest percentage of F1 among 20-24 years old college students (Panel A) and the ten states with the smallest percentage of F1 among college students (Panel B).

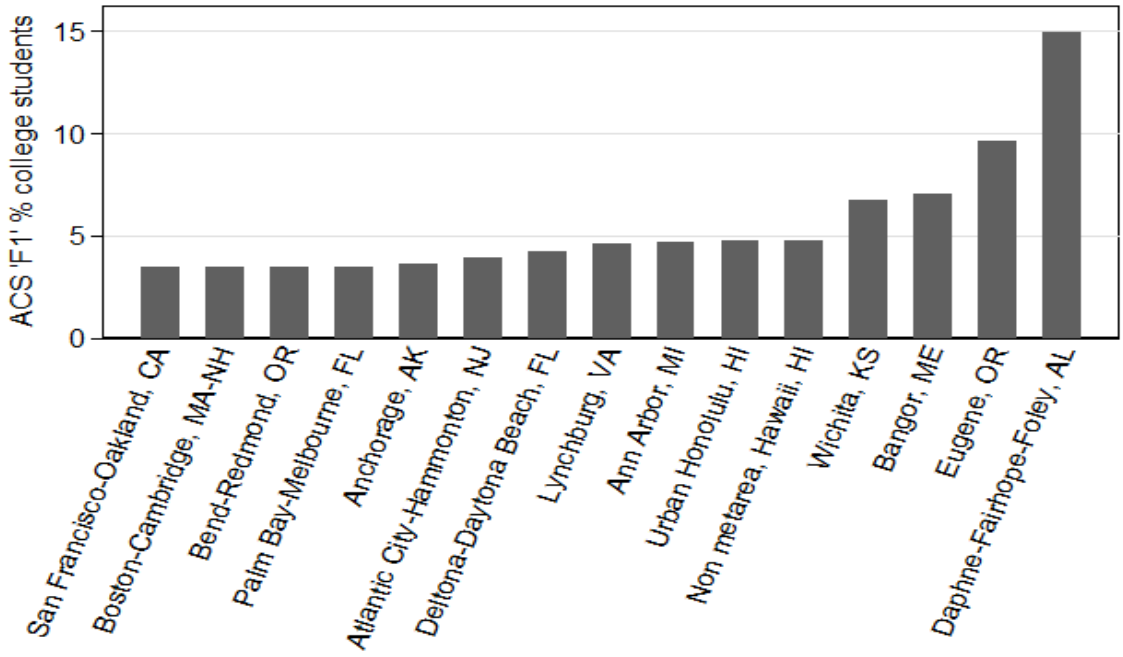
Figure 4
Map of ACS-F1 students as percentage of 20-24 years old college students
US states (excluding Alaska and Hawaii)



Note: The map shows the percentage of F1 foreign students in the college population of each state. Darker color implies larger share. The share is calculated from ACS data as described in the text and it is relative to the period 2005-2009.

Figure 5

US metropolitan areas with highest F1 visa students as percentage of 20-24 years old college student

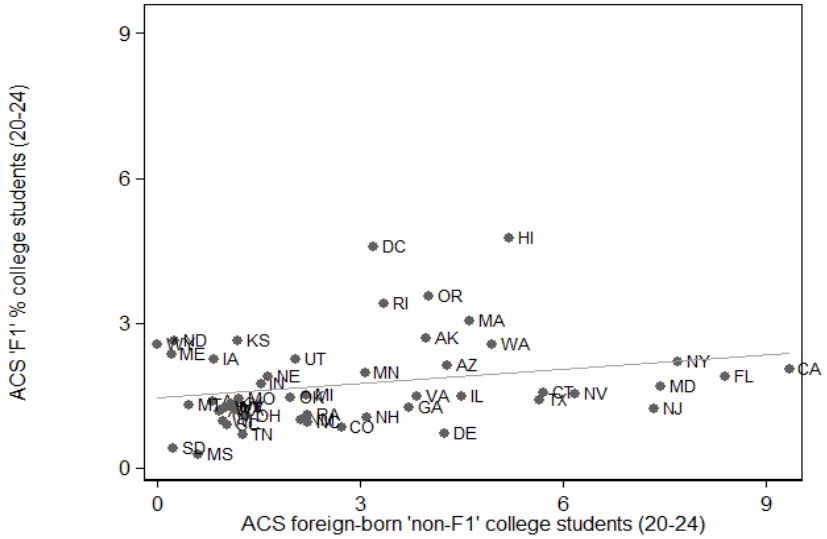


Note: The chart shows the 15 metropolitan areas with the largest percentage of F1 among 20-24 years old college students. F1 students are defined from the ACS following the method described in the text. The data are relative to 2005-2009.

Figure 6

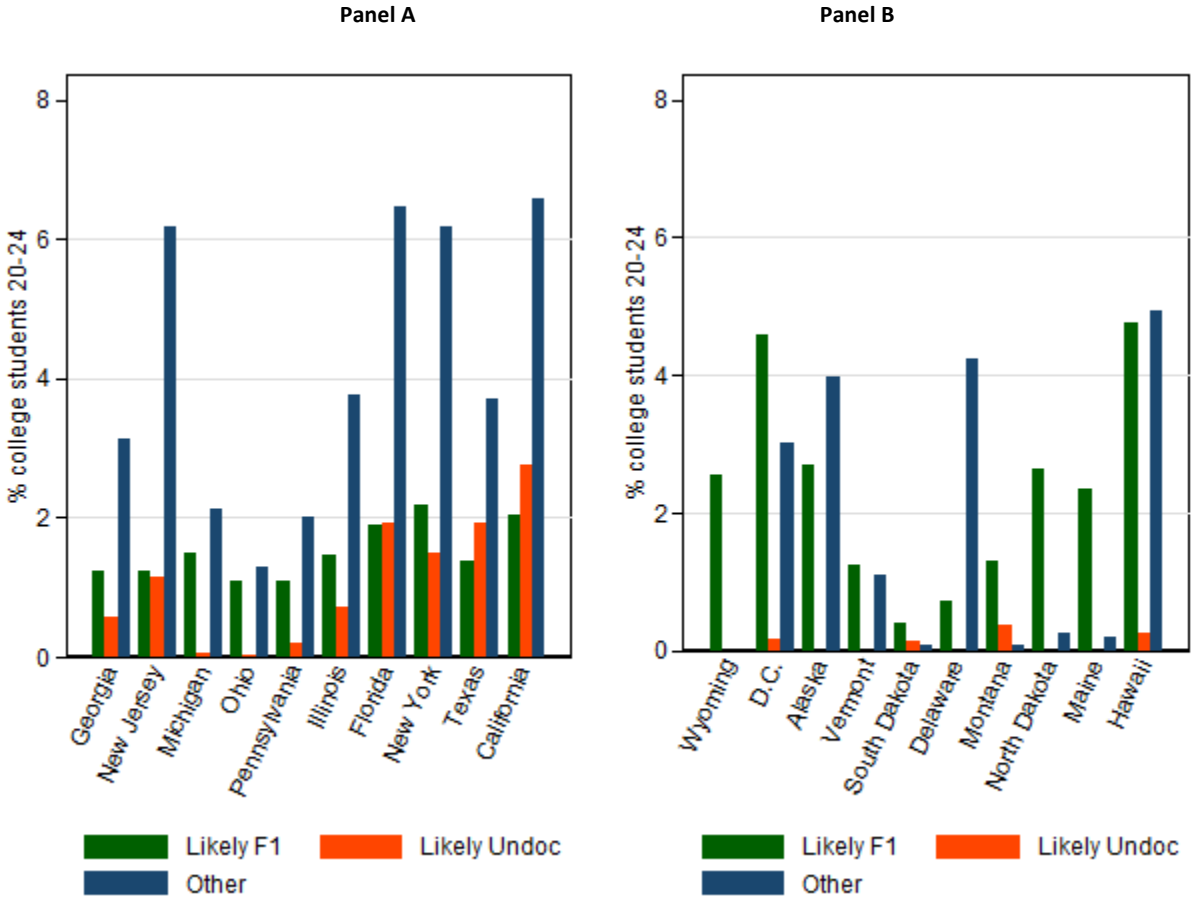
Correlation between F1 and non-F1 foreign-born as share of 20-24 years old college students,

ACS data by state (with linear regression line)



Note: F1 and non-F1 students are calculated form the ACS as described in the text. The period considered is 2005-2009.

Figure 7.
Non-citizen students as percentage of college students:
F1, likely undocumented and likely documented non-F1
10 states with largest (left graph) and smallest (right graph) foreign share



Note: The bar chart shows the foreign students as percentage of the college population age 20-24 in the period 2005-2009, divided into three groups: F1 students (green), likely undocumented students (orange) and non-F1 likely documented students (Blue). Panel A shows the ten states with largest percentage of total foreign students and Panel B the 10 with the lowest percentage.

Table 2.

Estimated coefficients of transition college-local employment for foreign students

US states, cohort of college students age 20-24 in 2005-2009 and college educated in 2010-2014

	(1) Baseline	(2) No California	(3) Weighted
Foreign-born F1	0.01	0.00	-0.04
	(0.17)	(0.18)	(0.17)
Foreign-born non-F1	0.90**	0.92**	0.87**
	(0.07)	(0.08)	(0.04)
R-squared	0.86	0.84	0.95
Observations	51	50	51

Note: Each column shows the coefficients from a regression as (1) in the text. The units of observation are US states. Column (1) shows the baseline specification including all states plus DC, Column (2) excludes California, whose percentage of foreign students is largest. Column (3) weights each observation for the size of the considered cohort (age 20-24 in 2005-09) in the State. Heteroscedasticity robust standard errors are reported in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Table 3.

Estimated coefficient of transition college-local employment for foreign students

US metropolitan areas, cohort of college students age 20-24 in 2005-2009 and college educated in 2010-2014

	(1) Baseline	(2) 100 Largest Metro Areas8	(3) Weighted
Foreign-born F1	0.10	0.00	0.11
	(0.11)	(0.16)	(0.12)
Foreign-born non-F1	0.60**	0.88**	0.78**
	(0.06)	(0.06)	(0.04)
R-squared	0.46	0.81	0.81
Observations	277	100	277

Note: Each column shows the coefficients from a regression as (1) in the text. The units of observation are 277 metropolitan areas. Column (1) shows the baseline specification including all Metropolitan areas, Column (2) includes only the 100 largest metro areas. Column (3) weights each observation for the size of the considered cohort (age 20-24 in 2005-09) in the Metro area. Heteroscedasticity robust standard errors are reported in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Table 4.

Estimated coefficient of transition college-local employment, separating undocumented

US States, cohort of college students age 20-24 in 2005-2009 and college educated in 2010-2014

	(1) Baseline	(2) Weighted	(3) Weighted, no CA	(4) Region FE	(5) Division FE
Foreign-born F1	0.00	-0.06	-0.05	-0.11	-0.13
	(0.19)	(0.18)	(0.17)	(0.17)	(0.20)
Foreign-born likely documented	0.92**	0.92**	0.90**	0.88**	0.96**
	(0.13)	(0.13)	(0.12)	(0.13)	(0.17)
Foreign-born likely undocumented	0.85**	0.77**	0.93**	0.83*	0.66+
	(0.28)	(0.25)	(0.25)	(0.32)	(0.36)
R-squared	0.86	0.95	0.93	0.95	0.96
Observations	51	51	50	51	51

Note: Each column shows the coefficients from a regression as (2) in the text. The units of observation are US states. Column (1) shows the baseline specification including all states plus DC, Column (2) weights each observation for the size of the considered cohort (age 20-24 in 2005-09) in the State. Column (3) excludes California. Column (4) adds census region fixed effects and Column (5) adds census division fixed effects. Heteroscedasticity robust standard errors are reported in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Table 5.

Estimated coefficient of transition college-local employment, separating undocumented

US metropolitan areas, cohort of college students age 20-24 in 2005-2009 and college educated in 2010-2014

	(1) Baseline	(2) Weighted	(3) Weighted, 100 Largest	(4) Region FE	(5) Division FE	(6) State FE	(7) State-clustered s.e.
Foreign-born F1	0.11	0.09	0.07	0.07	0.07	0.14	0.09
	(0.12)	(0.12)	(0.17)	(0.12)	(0.12)	(0.15)	(0.14)
Foreign-born likely documented	0.58**	0.82**	0.90**	0.81**	0.82**	0.79**	0.82**
	(0.10)	(0.08)	(0.12)	(0.08)	(0.08)	(0.09)	(0.08)
Foreign-born likely undocumented	0.63**	0.67**	0.55*	0.65**	0.60**	0.48+	0.67**
	(0.17)	(0.16)	(0.24)	(0.19)	(0.18)	(0.25)	(0.21)
R-squared	0.46	0.81	0.89	0.81	0.82	0.84	0.81
Observations	277	277	100	277	277	277	277

Note: Each column shows the coefficients from a regression as (2) in the text. The units of observation are 277 metropolitan areas. Column (1) shows the baseline specification including all metropolitan areas, Column (2) weights each observation for the size of the considered cohort (age 20-24 in 2005-09) in the metro area. Column (3) includes only the 100 largest metro areas. Column (4) includes region fixed effects, Column (5) includes division fixed effects, column (6) includes state fixed effects and column (7) reports standard errors clustered at the state level. Heteroscedasticity robust standard errors are reported in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Table 6.

Loss of F1-students employment as share of college-educated cohort

Top 10 states, cohort of college students in age group 20-24 in 2005-2009

	State	Share lost
1	Hawaii	0.042
2	District of Columbia	0.040
3	Oregon	0.031
4	Rhode Island	0.030
5	Massachusetts	0.027
6	Alaska	0.024
7	North Dakota	0.023
8	Kansas	0.023
9	Wyoming	0.022
10	Washington	0.022

Note: We calculate the share of the cohort lost to employment by multiplying for each state the share of F1 students by the difference in the estimated transition probability for F1 and non-F1 foreign students from college education into employment. The cohort considered is the one in the age group 20-24 during the period 2005-2009 and attending college. The coefficients used are those from column (3) of Table 2.

Table 7.

Loss of undocumented students' employment as share of college-educated cohort

Top 10 states, cohort of college students in age group 20-24 in 2005-2009

	State	Share lost
1	California	0.004
2	Texas	0.003
3	Florida	0.003
4	Arizona	0.002
5	New York	0.002
6	New Jersey	0.002
7	New Mexico	0.002
8	Nevada	0.001
9	Massachusetts	0.001
10	Illinois	0.001

Note: We calculate the share of the cohort lost to employment by multiplying for each state the share of likely undocumented students by the difference in the estimated transition probability for likely documented and likely undocumented foreign students from college education into employment. The cohort considered is the one in the age group 20-24 during the period 2005-2009 and attending college. The coefficients used are those from column (2) of Table 4.

Table 8.

Loss of wage income from lower transition rates of F1-students into local employment

Top 10 states in US 2013 $

	State	Dollars lost
1.	California	1,859,043,840
2.	New York	1,461,070,720
3.	Texas	799,726,592
4.	Washington	673,512,704
5.	Massachusetts	586,626,496
6.	Illinois	558,426,368
7.	Florida	515,591,904
8.	New Jersey	422,897,216
9.	Ohio	414,434,880
10.	Minnesota	392,186,592

Note: We calculate the wage income lost by taking the difference in the estimated transition probability for F1 and non-F1 foreign students from college education into employment in the state and multiplying it by the number of F1 students in the state (2005-2009), by the employment rate of foreign college educated in the cohort, and by the average wage of college-educated foreign born in 2010-2014. The cohorts considered are those in the age group 20-24 during the period 2005-2009 and attending college. Their employment rate and wage is evaluated in the period 2010-2014 as the cohort is 25-29 years of age in the same state. The coefficients used are those from column (3) of Table 2.

Table 9.

Loss of wage income from lower transition-rates of undocumented students into local employment

Top 10 states in US 2013 $

	State	Dollars lost
1.	California	421,336,896
2.	Texas	186,487,136
3.	New York	168,018,240
4.	Florida	87,906,880
5.	New Jersey	65,823,192
6.	Illinois	46,445,912
7.	Arizona	30,450,578
8.	Massachusetts	29,567,834
9.	North Carolina	18,474,140
10.	Washington	17,654,902

Note: We calculate the wage income lost by taking the difference in the estimated transition probability for likely documented and likely undocumented foreign students from college education into employment in the state and multiplying it by the number of likely undocumented students in the state (2005-2009), by the employment rate of foreign college educated in the cohort, and by the average wage of college-educated foreign born in 2010-2014. The cohorts considered are those in the age group 20-24 during the period 2005-2009 and attending college. Their employment rate and wage is evaluated in the period 2010-2014 as the cohort is 25-29 years of age in the same state. The coefficients used are those from column (2) of Table 4.

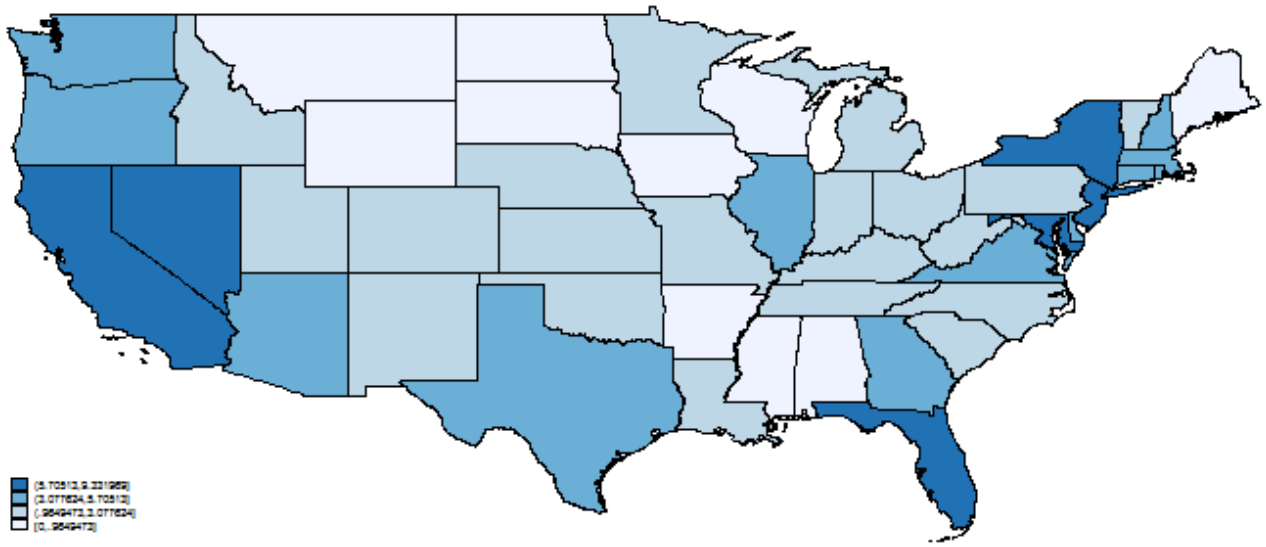
Appendix Tables and Figures

Table A1.
Number of foreign-born college students, F1 and non F1 by nationality

	F1 (ACS)	Non F1 (ACS)
Canada	51,466	74,735
Rest of Americas	359,774	1,002,290
Mexico	159,230	787,907
Western Europe	924,86	123,387
Eastern Europe	164,217	338,684
China	146,357	196,053
Japan	93,893	45,769
Korea	130,265	155,757
Philippines	32,759	154,925
Vietnam	22,695	88,917
India	73,211	180,296
Rest of Asia	158,794	231,888
Africa	255,605	335,494
Oceania	12,269	2,0518
Other	2,475	3,780

Note: Source: ACS, year 2005-2009. F1 college students are identified as those non-citizens who arrived in the US at 16 or older and do not live in a household as dependent. This definition matches best the number of F1 students as reported in the SEVIS (USCIS) over the period 2005-2009, by state. Non-F1 college students are foreign-born who do not match the F1 definition.

Figure A1
Map of non-F1 students (from ACS) as percentage of College students
US states (excluding Alaska and Hawaii)



Note: The map shows the percentage of non-F1 foreign students in the college population of each state. Darker color implies larger share. The share is calculated from ACS data as described in the text and it is relative to the period 2005-2009.

Table A2:
Schools with largest population of F1 visas nationally, period 2005-2009

State	School	Number of F1 students
NY	The City University of New York	44,343
CA	Santa Monica College	21,943
TX	Houston Community College System	17,955
IN	Purdue University	17,259
IN	Indiana University	17,111
MI	Michigan State University	14,912
IL	University of Illinois	13,129
CA	Academy of Art University	12,320
TX	The University of Texas at El Paso	12,178
UT	Brigham Young University	12,139
CA	San Francisco State University (SFSU)	11,594
WA	University of Washington	11,346
NY	The New School	10,953
CA	University of Southern California	10,880
HI	Brigham Young University-Hawaii	10,530
AZ	Arizona State University	10,493
OH	The Ohio State University	10,201
MA	Boston University	10,143
FL	Miami Dade College	10,107
NY	State University of New York at Buffalo	10,015
MN	University of Minnesota	9,673
PA	The Pennsylvania State University	9,577
OR	University of Oregon	8,938
WI	University of Wisconsin-Madison	8,932
NY	New York University	8,771
CA	California State University, Northridge	8,442
FL	Florida International University	8,202
CA	City College of San Francisco	8,095
MI	University of Michigan	7,974
PA	University of Pennsylvania	7,914

Note: The data source is the SEVIS system of the USCIS that records all approved F1 visas. The figures are cumulative for the period 2005-2009.