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Human Capital Redistribution in the USA: The Migration of the College-bound

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Abstract

Almost all the contributions on human capital and migration have focused on individuals who recently completed a tertiary education degree. Not much has been done with regard to high-school leavers. However, studying the migration of high-school leavers (college-bound individuals), is at least as important as studying college graduates' migration. We present an analysis of college-bound individuals' migration patterns for the USA. We argue that understanding the main determinants of these migration patterns is fundamental for policy makers in their 'quest for human capital retention'.

1. Introduction

The importance of human capital for both individuals and society is one of the few facts on which most economists (and other social scientists) would agree. The groundbreaking article by Schultz, "Investment in human capital", published in the *American Economic Review* in 1961 has over 5,500 Google Scholar citations. This, coupled with over 1.4 million Google Scholar websites on the 'human capital' topic, gives a sense of just how popular the concept has been over the years.

Initially just linked to increased personal returns, the concept of human capital soon found application in other areas of economics and in particular in development, both international and regional. Lucas's 1988 model of endogenous growth explicitly recognized human capital as the real 'engine of growth'.

Ever since Lucas's contribution, a lot of attention has been paid to the problem of human capital 'production' and to the externalities and spillovers deriving from it. However, producing human capital is a necessary but not sufficient condition to guarantee local development because of the fundamental role that migration plays.

Individuals do migrate, but better-educated individuals (i.e. those with higher human capital) migrate farther and more often. A region/country aiming at increasing its human capital by

investing in educational infrastructure has to consider this fundamental role of migration. A region successful in ‘stealing’ human capital produced elsewhere might improve its relative position even without costly investment in education. So, what are the factors that attract and/or retain human capital in a region?

Many studies have sought to answer this question, but two gaps are still evident. The first is a ‘geographical’ gap. While the USA leads the way in studying many economic phenomena, internal human capital migration has been better analyzed in Europe (and more recently also in Australia). The lack of US-specific comprehensive micro data on the topic is one of the main reasons of this shortcoming. The second gap is a ‘theoretical’ one. Almost all the contributions on human capital and migration have focused on individuals who completed a tertiary education degree, but not much has been done with regard to high-school leavers. We argue that studying the migration of high-school leavers, college-bound, individuals, is at least as important as studying college graduates’ migration and can help policy makers in their ‘quest to human capital retention’.

The aim of this paper is to fill these gaps by proposing a study of the inter-state migration of ‘college-bound’ high school leavers in the US. To our knowledge the only other contribution on this topic is Cooke and Boyle (2011). However, our analysis departs from Cooke and Boyle (2011) in two crucial aspects. First, we propose a different methodology that provides, we argue, clearer and more reliable estimation results. Second, we are interested not only in the overall migration flows of the college-bound, but also – and more crucially – in the ‘quality’ of these flows and their potential for human capital redistribution in the USA.

The paper is organized as follows. Section 2 presents the research background. Section 3 introduces the empirical methodology followed by a description of the data in Section 4. Section 5 describes and comments on our results. Finally, Section 6 concludes and presents possible avenues for further research.

2. Research background and aims

While in Europe several studies have focused on the interregional migration of highly educated people, the literature on migration patterns of students and graduates in the USA is surprisingly thin. It is, indeed, very difficult to find a good source of data which covers the very complex US educational system. Micro-data on individual students and graduates comparable to those used by, for example, Faggian and McCann (2006; 2007a; 2009a,b) for the case of the UK, Venhorst (2012, 2013) for the Netherlands or Corcoran et al. (2010) for Australia are not available for the whole of the US.

This is undoubtedly due to the complexity of the US educational system, but it is also due to a lack of coordination among the different US states. Projects to collect data for individual states – such as the one described by Yousefi and Rives (1987) for Iowa, Hansen et al. (2003) for Pennsylvania or the Indiana Fiscal Institute for Indiana (2000) – have been carried out recently and formed the basis for state reports on the attraction and retention of highly skilled workers. However, the data collected by different states are not comparable and hence a national coherent database does not exist.

When a national dataset does exist, it focuses on specific categories of individuals. The National Survey of Recent College Graduates (NSRCG) and the National Survey of College Graduates (NSCG) by the National Science Foundation (NSF), for instance, do provide information on the labor market outcomes of individuals who recently obtained a college degree, but the sample is restricted to graduates in science, engineering or health (SEH). These are the data used in two studies by Tornatzky et al. (2001) and Gottlieb and Joseph (2006) on college-to-work migration of technology graduates and PhDs.

Other studies, also focused on college-to-work migration, used different data sources. Kodrzycki (2001), for example, uses the National Longitudinal Survey of Youth (NLSY) by the US Bureau of Labor Statistics, which covers the period 1979–1996. However, the NLSY includes a sample of only about 6,000 individuals and it is not just for college graduates. Individuals with a college degree or more are only 1,320 and this raises questions on the representativeness of the sample for the whole US and the validity of the results.

A more comprehensive source of micro-data is the Integrated Public Use Microdata Series (IPUMS) that comes from the decennial censuses. Winters (2011) uses the 2000 IPUMS data to study the connection between human capital and population growth in the American MSAs by looking at who moves to ‘smart’ cities. His results are in line with the findings of Franklin (2003), who – also using Census data – finds that the ‘young, single and college-educated’ tend to disproportionately locate in central urban areas.

Census micro-data have also been used to look at specific migration determinants of the college-educated. Whisler et al. (2008) focused on the effect of amenities, while Wozniak (2010) looks at the effect of distant labor market opportunities on college graduate migration decisions. Their combined results suggest that both quality of life factors and employment opportunities play a crucial role in the migration decisions, and choice of residence, of highly educated individuals.

One factor that does not play a central role in these micro-studies is, however, the ‘migration history’ of college-graduates. Having previously experienced migration to go to college can make individuals more ‘footloose’ and hence more likely to move again after graduation (see Faggian and McCann 2007a, 2009b for the case of British graduates). However, in the case of the US, several contributions have noted how individuals who leave their state after high school to go to college in another state have a high probability to remain in the latter to work after completing their degree.

Gottlieb and Joseph (2006) show that college graduates have a ‘*large and significant tendency to stay*’ (p. 653) in the location where the most recent degree was earned reflecting the ‘*psychic costs of moving*’ (p. 648). Along the same lines, Groen (2004) and Groen and White (2004) find that attending college in a state increases the chances of an individual’s living in that state several years after graduation. Huffman and Quigley (2002) and Blackwell et al. (2002) find similar results for the specific cases of graduates from the University of Berkeley (Haas School of Business and College of Engineering) and Xavier University in Cincinnati respectively.

It seems that, at least in the case of the USA, the decision of where to attend college plays a pivotal role in the subsequent location decision post-graduation. So much so that Tornatzky et al. (2001), talking about ways of retaining and attracting high-human capital individuals, argue that *'states can gain significant relative advantage by harvesting talented high school graduates from their state by aggressively encouraging and giving them incentives to stay home for college'* (p. 654).

This being the case, studying the migration patterns of college-bound high-school leavers becomes fundamental. Where are the college-bound going and why? And, more importantly, are states simply swapping students of equal 'quality' or is there a human capital redistribution that is happening already at the level of high-school leavers?

Our contribution aims at answering these questions by studying the inter-state migration flows of college-bound high school leavers. To our knowledge, the only other contribution attempting to do something similar is the paper mentioned above by Cooke and Boyle (2011). Using Integrated Postsecondary Education Database System (IPEDS) data for 2007, Cooke and Boyle show that economic, school-related and amenity factors are all highly significant determinants of high school to college migration. To demonstrate this, they use a Poisson model. However, as we will explain in more detail in the methodology section, we argue that the Poisson model suffers from serious biases in estimation when the data are – as in the case of the IPEDS dataset – over-dispersed. Beyond using a different methodology, we also separate the flows by a proxy for human capital 'quality' (measured with institutional variables). This allows us to study the potential redistribution of human capital among USA states and also identify the differences in migration determinants across flows where the destination is schools of highly varying quality.

3. Modeling framework

Following the approach proposed by Douglas and Wall (1993) - and similar to the implementation by Faggian and Royuela (2010) to study migration flows in the Barcelona area - we assume that a prospective college student decides where to move by comparing the utility of the current location (origin) to that of the alternative location (destination). The utility of the i -th location for the k -th individual can be expressed as:

$$U_i^k = u(\mathbf{S}, \mathbf{E}, \mathbf{A}) + \varepsilon_i^k \quad (1)$$

where the total utility U includes a deterministic part u , 'common' to all individuals (i.e. on which there is 'consensus') and a stochastic part ε_i^k reflecting individual idiosyncratic tastes. The 'common' part u is, in turn, a function of a vector of economic variables E_i , regional amenities A_i and school characteristics S_i .

Assuming the k -th high-school leaver is free to move from location i to location j , we can define the probability of migrating from i to j as

$$\Pr(M_{ij}^k = 1) = F(U_j - U_i - C_{ij}, U_j - U_1 - C_{ij} + C_{j1}, \dots, U_j - U_r - C_{ij} + C_{jr}) \quad \text{with } r \neq i \quad (2)$$

This probability is equal to 1 if the individual does decide to move and 0 otherwise and it is a function of the difference in utility between the chosen destination and the origin, the moving costs (C_{ij}), and the utility differentials between j and the all the other possible r alternative locations.

By defining Δ_{ji}^k as being equal to the difference in the expected values of the idiosyncratic components associated to two alternative locations for individual k , i.e. $\Delta_{ji}^k = E(\varepsilon_j^k) - E(\varepsilon_i^k)$ and assuming a linear functional form, equation (2) can be rewritten as:

$$\Pr(M_{ij}^k = 1) = \alpha(u_j - u_i - C_{ij} + \Delta_{ji}^k) + \beta \left(\sum_{r=1}^R u_j - u_r - C_{ij} + C_{jr} + \Delta_{jr}^k \right) \quad \text{with } r \neq i \quad (3)$$

The probability of moving from i to j is strictly increasing in the ‘common’ part of utility of location j and strictly decreasing in the ‘common’ part of utility associated with location i and moving costs.

The estimation of the conditional logit probability in equation (3) is problematic because it is at the ‘individual’ level, while most migration data are at a more ‘aggregate’ level (such as states or regions).

Guimarães et al (2000, 2003) show that the number of choices in a conditional logit is equal to the number of observations in a Poisson regression, so that, under certain conditions, estimating equation (3) is equivalent to estimating a Poisson model of this type:

$$\Pr(Y_{ij} = M_{ij}) = F(u_j - u_i - C_{ij} + \Delta_{ji}^k, \dots, u_j - u_r - C_{ij} + C_{jr} + \Delta_{jr}^k, P_i, L_j) = \frac{e^{-M_{ij}} \mu_{ij}^{M_{ij}}}{M_{ij}!} \quad (4)$$

where L_j is the size of location j (e.g. measured in terms of population), P_i is the population of the origin i and Y_{ij} is a random Poisson distributed variable with parameter μ_{ij} defined as:

$$\mu_{ij} = \exp(\eta) = F(u_j - u_i - C_{ij}, P_i, L_j) \quad (5)$$

The advantage of this second approach is that it is much easier to implement econometrically.

In equation (5), similarly to equation (3), migration flows between i and j increase with an increase in ‘common’ utility differentials between destination and origin, a decrease in moving costs and an increase in “migration opportunities” (in turn a function of the size of the origin and the amount of locations in the municipality chosen as destination).

However, one of the main problems of the Poisson distribution is that it assumes the equality between mean and variance (equidispersion) or analytically:

$$\mu_i = \exp(\mathbf{x}_i \beta) = E[y_i | \mathbf{x}_i] = \text{Var}[y_i | \mathbf{x}_i] \quad (6)$$

where $\mathbf{x}_i$ is the vector of explanatory variables.

However, very often data show *overdispersion*, i.e. a variance well above the value of the mean. This intuitively means that values in the ‘tails’ are more common than predicted by the Poisson theoretical distribution. As such, the conventional Poisson mean-variance restriction produces *seriously biased* parameter estimates (Cameron and Trivedi 1998, and Wang *et al.* 1996).

This problem is solved by the use of *mixture models*, which explicitly model heterogeneity among observations by adding an extra parameter, a function of the *unobserved* heterogeneity. Analytically, the mean in Equation (6) becomes:

$$\mu_i^* = \exp(x_i\beta)\exp(\varepsilon_i) \quad (7)$$

The negative binomial model is a specific case of mixture models in which $\exp(\varepsilon_i)$ is supposed to be drawn from a gamma distribution so that the probability density is:

$$\Pr(y=M=x) = \frac{\Gamma(y+\alpha^{-1})}{y!\Gamma(\alpha^{-1})} \left[\frac{\alpha^{-1}}{\alpha^{-1}+\mu} \right]^{\alpha^{-1}} \left[\frac{\mu}{\alpha^{-1}+\mu} \right]^y \quad (8)$$

where Γ indicates the standard gamma function and α determines the degree of dispersion in the predictions (the larger α , the more spread are the data). If $\alpha=0$, the binomial negative model reduces to the Poisson regression model.

Cooke and Boyle (2011) ignore the problem of overdispersion in the IPEDS data. This creates biased results and a surprisingly high value of the pseudo- R^2 (0.8310). Because the pseudo R^2 is not, contrary to the OLS R^2 , a measure of the percentage of the variance explained, but rather a ratio of two maximum likelihood values, acceptable values normally range between 0.20 and 0.40. It is very unusual to find values as high as 0.80 and, when that happens, it could be due to unreasonably high z-scores for some of the explanatory variables. Cooke and Boyle (2011) do not report the z-scores for their coefficients, so it is difficult to assess whether this is their problem. However, all the explanatory variables in their models are reported to be highly significant. Our expectation is that economic variables would play less of a role in determining high school graduates flows. We expect high school graduates to maximize their utility function over a relative short time-span or, in other words, to be rather *short-sighted*, which would imply that they weigh more heavily factors such as college quality and quality of life in the destination area rather than general economic, labor market conditions.

4. Data, empirical implementation and testable hypotheses

Our main source of data is the 2008 Integrated Post Secondary Education Database (IPEDS). The IPEDS data, which summarize information that higher education institutions receiving federal funding are required to submit (such as graduate rates and the racial and ethnic composition of students), include the state of residence for college freshmen at time of application. It is important to note that the data collected, whether related to migration or demographic composition, are never at the individual student level, but rather at the institutional level. In an ideal world, statistics could be collected as a matter of course at the

student level and would identify not only if and where a student goes to university, but also the student's household background and his or her academic credentials. All two- and four-year public and private (non-profit) schools offering at least an associate's degree and having "full-time, first time undergraduates" are included. This gives a total of 2,830 higher education institutions (from now on referred to as HEIs).¹

The IPEDS data are aggregated by state to create state-to-state flows of college freshmen and combined with data from the decennial census on economic and quality of life state characteristics and data on HEIs characteristics. State-to-state flows are also disaggregated by human capital 'quality'. This is done, following the approach by Carnevale and Rose (2004) and Hoxby and Avery (2013), using Barron's *Profiles of American Colleges* (2009). Based on the average test scores and grades of their students, schools are classified as:

- High quality (n=181): Barron's most and highly competitive categories (e.g. Princeton, but also Tufts or Ohio State University)
- Medium quality (n=270): Barron's very competitive category (e.g. Michigan State University or Drexel University)
- Lower quality (n=828): Barron's competitive and less competitive categories (e.g. many California State University campuses)
- Other (n=529): Non-competitive or special schools
- Community colleges (n=1,022): Directly identified by the IPEDS data

Based on the classification above, which in turn is based on the average academic qualifications of the students attending each type of college/university, we associate the quality of the institution with the quality of the student. This is not a perfect match: some highly qualified students may choose to attend a less selective school, although we feel that, in these cases, the students would be unlikely to migrate at all and will stay in state for college. The reverse case, that an unqualified student would gain entry to the most selective school is almost impossible to conceive. In view of the lack of more direct observation of student-leaver quality, our conflation of student and HEI quality is our best opportunity of being able to assess the impact of quality on student migration patterns. Henceforth, when we refer to "high quality" students, what we really mean is that these individuals possessed the observable requirements for entry to the most selective HEIs.

To analyze the state-to-state flows of college freshmen we employ a bipartite methodology. First, we provide some descriptive statistics of the flows combined with map visualization. Second, we use a negative binomial regression to estimate a gravity-type model of interstate student flows (both overall and divided by quality) and identify their most important determinants.

The basic gravity-type model estimated can be expressed as:

¹The IPEDS data are available on an annual basis, however the fraction of institutions providing information on the 'migration' question varies wildly. In 2008 only 43 institutions failed to answer the question regarding state origins of incoming first-year students and are therefore excluded from this analysis. In 2009, for example, the corresponding number was 1,248 and in 2003 it was 1,013.

$$M_{ij} = \alpha + \beta GEO_z + \gamma ECO_z + \delta QoL_z + \theta HEI_z + \varepsilon_{ij} \quad \text{with } z=i, j$$

where M_{ij} is the gross-migration flow between each pair of states (including the District of Columbia and excluding Hawaii and Alaska) with a total number of observations $n=2,352$ ($49 \times 49 - 49$). **GEO**, **ECO**, **QoL** and **HEI** are vectors of geographical, economic, quality of life and higher education institutions characteristics respectively. Although, in the spirit of the traditional gravity model, we include both destination characteristics, $z=j$, ('pull' factors) and origin characteristics, $z=i$, ('push' factors), in the case of young people 'pull' factors have been shown to weigh more heavily on the decision to out-migrate (Faggian, 2005). This might be because young people have decided already to migrate anyway and are considering 'where' to migrate, rather than 'if' they want to migrate (which would imply a higher weight on push factors).

In the geographical variables, in the spirit of the gravity-employment model à la Lowry (1966), we include a distance variable, measured in miles between the centroids of the origin and destination state. Also following the basic gravity model, we include the size of the origin and destination states (measured by the log of their populations). Two dummy variables for neighboring states and states belonging to the same US division are also included. Neighboring states or states within the same division might share common cultural values and this might favor an exchange of migrants. Moreover, Millimet and Osang (2007) find a large and economically significant subnational border effect on interstate trade flows in the US. Young people might feel more comfortable to just cross the border rather than move to non-adjacent states (irrespective of physical distance). However, we expect distance to be less of a deterrent for students attending higher quality HEIs for several reasons. First, individuals with more human capital should have a superior ability to process and find information, efficiently reducing information costs (Schultz, 1975). Second, individuals with lower human capital are generally more reliant on family and friends (DaVanzo, 1983). Hence, a long distance move is psychologically more costly for them. Third, if it is true that individuals with higher human capital have to expand their search radius to find a better job to match their skills (Schwartz, 1976), it is also true that they have to expand their search radius to enter selective HEIs, which are in limited number. As a result more selective HEIs have a national market (or 'catchment area') while less selective HEIs cater more for local students. This has been shown for the case of the UK (Faggian and McCann, 2009b), and it is reasonable to expect the same in the US context. All this brings us to a formulation of our first hypothesis to be tested with our empirical model.

Hypothesis 1: Although distance (both geographical and cultural) is a deterrent to move, higher human capital students are expected to be more inclined to move longer distances.

US evidence suggests that non-economic factors such as natural amenities (Partridge and Rickman, 2003) are a key driver in influencing migration patterns of the general population. However, empirical work focused specifically on younger age cohorts and college graduates has found amenities to be less important than economic factors as migration drivers (Gottlieb, 2003; Hansen et al. 2003; Tornatzky et al. 2001; Kodrzycki, 2001). To test

whether this is the case also for high school leavers, we include in the model two quality of life factors, i.e. the USDA amenity index and the vicinity to the ocean. The USDA amenity index is widely used in migration studies and is constructed by combining six measures of climate and topography: warm winter, winter sun, temperate summer, low summer humidity, topographic variation, and water area. The index goes from 1 (lowest amenities) to 7 (highest amenities). Vicinity to the ocean is a proxy for coastal amenities (Nelson, 2009) and has been used extensively in migration studies, together with the USDA amenity index, to proxy for natural amenities (Partridge et al. 2008, 2010, 2012). Coastal amenities might be particularly attractive to young people. However, the ‘pull’ of amenities might be weaker for students going to more selective HEIs, either because they are more focused on choosing a location based on the HEIs characteristics or because they envisage having less time while studying to enjoy these amenities. This leads us to the second testable hypothesis.

Hypothesis 2: As it occurs for the general population, amenities are expected to be a significant and positive ‘pull’ factor for young individuals. However, this ‘pull’ might be weaker for students going to more selective HEIs. Although amenities in the origin are obviously a good factor, they might not be strong enough to stop young people from migrating. In other words, amenities might not act as a strong ‘retention’ factor even though they might help with relative ‘attraction’ of mobile students.

In line with the traditional ‘disequilibrium’ model of migration (Muth, 1971; Greenwood, 1975, 1985; Greenwood and Hunt, 1984) that treats interregional/interstate migration almost entirely as an economic phenomenon and a “by-product” of employment search, we also include in the model economic variables such as employment and population growth (between 1993 and 2007) and the percentage of people below the poverty line. However, our expectation is that college-bound individuals might be rather shortsighted and assign a lower value to these factors than to quality of life and, most of all, quality of higher education determinants. The work by Faggian (2005) shows that, indeed, this is the case in the UK, where high school leavers do not pay much attention to labor market factors when deciding which higher education institution to attend. Economic factors, however, do become very significant post-graduation.

Hypothesis 3: Labour market and regional economic characteristics are less important factors in the migration decision of college-bound individuals.

To measure the educational quality of the receiving states we use the percentage of degree holders over total population, the percentage of undergraduate places (vis-à-vis postgraduates) and the percentage of selective institutions over the total number of higher education institutions. The percentage of degree holders is a proxy for human capital (Becker, 1964) in the region. Although the use of education to measure human capital has been criticized and alternative theories, such as the creative class theory (Florida, 2002), have been proposed, education - and in particular the percentage of the adult population with a college degree - still remains the most commonly used and preferred measure of human capital (Berry and Glaeser, 2005). Both the percentage of undergraduate students (vis-à-vis postgraduates) and the percentage of selective institutions give an indication of the quality of HEIs, but from two different angles. A higher percentage of postgraduates indicates that the

institutions in the region are more research-intensive, while selectivity refers to the ratio between applications and acceptances. Both of these are often used as an indicator of quality. We expect educational factors to be highly relevant in the migration decision of high school leavers and, even more so, for individuals going to more selective HEIs. This leads to the following testable hypothesis.

Hypothesis 4: Educational variables are the most important determinant in the migration decision of high school leavers, especially those entering more selective HEIs.

Our last two control variables are the percentage of foreigners and the percentage of urban land. The percentage of foreigners is introduced to test the hypothesis of ‘cultural avoidance’ proposed by Faggian et al. (2012). In their contribution, the authors show that internal migration seems to respond negatively to the stock of foreign-born population in a state. However, their results refer to the entire population. It is interesting to test whether the same results hold for the sub-sample of high school leavers. It has been argued that more educated people and younger people might be more ‘tolerant’ towards diversity, and indeed the more selective HEIs in the US tend to display higher levels of racial and ethnic student diversity (Franklin, 2011), but this has not yet been tested empirically, so our fourth hypothesis can be formulated as follows.

Hypothesis 5: Cultural avoidance is less problematic for high-school leavers, and even more so for the ones entering more selective HEIs.

Finally, the percentage of urban land is a proxy to control for the attractiveness of cities. Many contributions have pointed out that the ‘young and bright’ are attracted to large cities because of the city ‘buzz’. Cities provide young and educated individuals with better career opportunities, entertainment and the possibility of interacting with like-minded individuals (Glaeser and Maré, 2001; Glaeser 2011). However, most of these studies look at individuals who have already graduated from college. The ‘college-bound’ are younger and not looking to enter the labor market full-time yet. It is interesting to see if, even for them, an urban location is preferable.

Hypothesis 6: More urbanized states attract more college-bound in-migrants.

Finally, on a more technical note, we use a ‘deep lag’ approach and lag all the explanatory variables to the year 1990 (unless otherwise stated in the name of the variable) to correct for potential endogeneity problems.

5. Results

5.1 Migration patterns: descriptive statistics and maps

We start by providing some basic descriptive statistics and maps of the interregional migration flows, both total and disaggregated by quality category.

Table 1 shows the ranking of States by net in-migration of college-bound students and by net in-migration of ‘high quality’ students. One striking feature of the two rankings is that they are, by no means, identical. The Spearman correlation coefficients between the two rankings

is 0.5052, showing that the states with the highest net inflows of students are not necessarily the ones with the highest net inflow of ‘high quality’ students.

The last column of Table 1 compares the ranking of states in terms of net inflows of student with the ranking obtained just by looking at the net inflows of high quality students. Not surprisingly Massachusetts (home of Harvard, MIT, and many other top-ranked institutions) tops the ranking when looking at inflows of high quality students, improving its relative position by eight positions. However, the states with most striking differences in rankings are New York (+33 positions), Georgia (+31), Minnesota (+29) and Michigan (+26). All these states seem to be ‘winners’ in attracting especially high quality students. On the other side of the spectrum, Alabama (−37 positions), Arizona (−32), Kentucky (−24), Oregon and Utah (−23) are all better in attracting medium or low quality students.

Certain states are better in attracting high quality students. Figures 1 and 2 show respectively the percentages of high and low quality gross inflows of students over the total inflows of students.

With the exceptions of California and partially Washington, the two maps combined clearly show a West-East divide. States along the East coast, but also some in the Midwest (Indiana, Wisconsin, Minnesota), have a high proportion of inflows being represented by high quality students – obviously a reflection of the quality of their local HEIs. On the opposite side, the Dakotas, Wyoming, Nevada, Oregon, but also states along the Mississippi river and the Appalachian mountains (traditionally poor) attract a high proportion of low quality students.

A high proportion of high quality student inflows, however, is not a guarantee of success, if associated with equally large outflows of high quality students. Figure 3 shows the geographical distribution of net migration (inflows-outflows) of high quality students.

The West-East divide appears even more demarcated in Figure 3. California, which does have a high proportion of high quality inflows has even larger high quality outflows ending up with an absolute loss of over 9,000 high quality students. This might signal an excess demand for high quality education in California not matched by the local HEIs, which in turn forces large number of high quality students to leave the state.

Among the ‘winners’ identified in Figure 3, some are more obvious (e.g. Massachusetts or Pennsylvania) than others (e.g. Wisconsin or the Carolinas).

5.2 Migration determinants: negative binomial regression

In the second part of our analysis we use a negative binomial regression to identify the main migration determinants of student flows. We estimate four different models, one for the overall flows and one for each of the three levels of ‘quality’ of human capital (i.e. high, medium and low).

Table 2 reports our results.

Although there are some interesting results in the model for all the students pooled together, such as the lack of significance of employment growth as pull factor, the most interesting

results emerge when separate models for different levels of ‘quality’ of the flows are estimated. The most telling results are found especially by comparing the two extremes, i.e. high and low quality students, while medium quality students are more of a ‘mixed’ bag.

First, in line with our Hypothesis 1, distance is less of a deterrent for individuals with higher human capital. Although the distance variable, as predicted by the standard gravity models, is negative and significant in all models, its effect and significance is strictly decreasing with the increase in quality of the flows. This is in line with human capital migration theory (Sjaastad, 1962) and is therefore not surprising. The exact same result holds for the dummy variables on neighboring states and states belonging to the same division. Once controlled for distance, both dummies remain significant showing that, *ceteris paribus*, students tend to prefer states which are bordering their residence state and/or at least belonging to the same division. This might be the result of college-bound high school leavers seeking states having similar institutions and culture to their own, or simply an effect of not wanting to be too far away from their network of family and friends (e.g. to visit them during vacation time). Also in line with the standard gravity models are the signs of the coefficients of the population variables (positive and significant), which serve as scaling factors.

In line with hypothesis 2, amenities are a significant ‘pull’ factor for all the students, and more so for low quality ones (for which the coefficient is about twice in magnitude). However, states bordering the ocean are more popular among high quality students, which was also obvious by looking at Figures 1 and 3. This is also in large part linked to the geographical distribution of high selective HEIs. This might also crowd out medium quality students who end up in areas not bordering the ocean (as shown by the negative coefficient as pull factor). Although bordering the ocean is also positive and significant as a push factor for high quality students², both the magnitude and the significance are far lower than as a pull factor, which means that, overall, destinations bordering the ocean are gaining.

Not totally unexpected is the effect of employment growth. High quality students, contrary to low quality ones, care less about the economic conditions of their destination and more about the quality of the HEI they will attend (in line with both hypotheses 3 and 4). It has been proven elsewhere (Faggian et al. 2009a,b; 2007a,b) that, for the case of the UK, the best students are more likely to be ‘repeat migrants’ - i.e. move away to college and then move away again (and not returning home) to look for a job – rather than ‘university stayers’ – i.e. those who move away for college and then stay there to look for employment. This might be the case for the USA too. This is not incompatible with the findings by Gottlieb and Joseph (2006), Groen (2004) and Tornatzky et al. (2001) that college graduates have a high chance to stay in the area where they study. First of all, none of the above contributions classify students according to ‘quality’. Second, it might be that the best students ‘think’ they will move again, but then become embedded in the area where they study and find employment there.

Also in line with hypothesis 4 is the fact that both ‘quantity’ and ‘quality’ of HEIs (measured by the percentage of undergraduates and the percentage of selective institutions)

²This might be linked with large outflows especially from California

play a decisive role in attracting high quality student flows, while they have virtually no role in attracting low quality flows. In fact, the presence of selective institutions is a deterrent for 'medium' quality flows' (and a significant 'push' factor for medium quality students). This result, although it might appear somewhat surprising, appears to be consistent with the argument of Bartel (1979) according to which the highest skilled individuals are first in the 'queue' when picking and they can choose the best opportunity locally thereby forcing others to move. Medium and high quality students might sometimes try to enter similar institutions, but high quality students have much higher chances to get in and crowd medium quality students out. Moreover, this result does not contradict the result on high quality students still being attracted to areas with a high percentage of selective institutions, as – if they decide to move – these are the areas they prefer.

Contrary to our expectations and to hypothesis 5, cultural avoidance does play a role among college-bound individuals and even more so for the ones entering selective HEIs. Without individual information on personal characteristics such as income or other factors (such as, for example, political affiliation), it is difficult to pinpoint (or even speculate) the exact cause of this maybe counterintuitive result. Finally, the 'urban factor' is an important 'pull' factor, but only for high quality flows (although rural areas act as a 'push' factor for medium and low quality flows) confirming hypothesis 6.

In general, 'pull' factors are more significant than 'push' factors, which is not surprising in the case of college-bound individuals and is consistent with findings elsewhere (e.g. Faggian 2005 for the UK).

6. Conclusions

Although much work still needs to be done on the topic of the migration of college-bound high school leavers in the USA, our findings help shed some light on some of the main patterns emerging using the IPEDS data.

First and foremost, students of different academic quality differ in their decision process of where to attend college and assign a different value to different migration determinants. High quality students are more focused on the type of HEIs they want to attend and less on the location of their preferred institution. Economic factors enter their decision process (and utility function) in a later stage - post-graduation - as other contributions on college graduate migration have pointed out. Low quality students seem, on the opposite, to weigh different factors more equally.

The geographical distribution of student flows also reveals some interesting patterns. There seems to be a clear West-East divide, which is even more demarcated for high quality flows. If, as Tornatzky et al. (2001) point out, attracting high quality students is the first - and most crucial - step towards retaining high quality graduates, then the Eastern (and some Midwest) states are clearly ahead in the race.

Some caveats and limitations clearly apply to our results. First, our analysis is just a one year snapshot. Although the IPEDS data are available for the multiple years, in this contribution we only focused on 2008, for two main reasons. First, the data for other years are missing

information for some institutions, which, given the nature of our data construction (summing institution-level data to create state-to-state flows), is not ideal. We are considering the most appropriate mechanisms for ensuring data quality for these other years. Second, 2008 can be seen as a pre-recession, typical student migration year. In the future, our intention is to test the robustness of our findings across the whole period. In particular, we are interested in the effects the economic recession might have had on the patterns of student mobility we observe here. Second, although we included the selectivity of institutions as one of our explanatory variables, we did not include any cost variable. This was done intentionally as entering a cost variable is not a straightforward procedure and needs to be thought of carefully. How to weight this variable at state level is not trivial and – if done incorrectly – might bias the results rather than improve them. Moreover, received knowledge in the U.S. suggests that few students pay the “sticker price” tuition, further complicating the accurate measurement of the role of cost as a migration determinant. A selectivity variable, although a rough proxy, serves well the purposes of our study at this stage. Third, the robustness of our results can also be tested by looking at the endogeneity problem more directly, e.g. by means of instrumental variables. The deep lag approach presented in this paper is rather common as it substantially reduces the endogeneity problem in a rather simple and straightforward manner. The instrumental variable approach has also been criticized and produces results that are also biased (although normally in the opposite direction of OLS).

One final point to highlight is the importance of studying college-bound high school leavers migration for policy purposes. States struggling in attracting and retaining high quality graduates should consider what kind of educational infrastructure they have and whether there is a need for change. A system inadequate for the needs of the local ‘young and bright’ individuals can have serious long-term negative effects on the local economy. California’s loss of high quality students is a perfect example. Priorities should also be clear. Although the best-case scenario is being able to both retain local students and attract (and retain) students from outside, the two might be incompatible for certain areas of the country. Most struggling states might be better off focusing on retaining their own high school leavers by offering them the right college opportunities locally in the hope that this will increase the overall graduate retention rate.

More coordination and better national micro-data on students and college graduates are also needed. The experience of the UK where a Higher Education Statistical Agency was created to collect and handle micro-data on students and graduates could be taken as an example. More comprehensive micro-data (comparable among states) are a *condition sine qua non* to better understand the process of human capital movement and redistribution in the USA.

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Figure 1.
Percentage of high quality flows

Figure 2.
Percentage of low quality flows

Figure 3.
Net in-migration of high quality students

Table 1

Ranking of US states by net-inflows of students

Net migration ALL students	Net migration HIGH QUALITY students	Diff. rankings
1 Pennsylvania	1 Massachusetts	8
2 Indiana	2 District of Columbia	4
3 North Carolina	3 Pennsylvania	-2
4 Alabama	4 North Carolina	-1
5 South Carolina	5 Wisconsin	21
6 District of Columbia	6 Rhode Island	1
7 Rhode Island	7 Indiana	-5
8 Iowa	8 South Carolina	-3
9 Massachusetts	9 New York	33
10 Utah	10 Virginia	10
11 West Virginia	11 Louisiana	3
12 Arizona	12 Tennessee	11
13 Kentucky	13 Georgia	31
14 Louisiana	14 Michigan	26
15 Mississippi	15 Maine	19
16 Vermont	16 Minnesota	29
17 Arkansas	17 Vermont	-1
18 Oklahoma	18 Arkansas	-1
19 North Dakota	19 Wyoming	10
20 Virginia	20 Ohio	16
21 Kansas	21 North Dakota	-2
22 Oregon	22 South Dakota	6
23 Tennessee	23 Iowa	-15
24 Delaware	24 Oklahoma	-6
25 Missouri	25 West Virginia	-14
26 Wisconsin	26 Montana	4
27 Idaho	27 Missouri	-2
28 South Dakota	28 Idaho	-1
29 Wyoming	29 Mississippi	-15
30 Montana	30 Connecticut	15
31 Nebraska	31 New Mexico	1
32 New Hampshire	32 Utah	-23
33 New Mexico	33 Nebraska	-3
34 Maine	34 Delaware	-11
35 Colorado	35 Nevada	1
36 Ohio	36 Kentucky	-24
37 Nevada	37 Washington	3

Net migration ALL students		Net migration HIGH QUALITY students		Diff. rankings
38 Michigan	-1772	38 New Hampshire	-579	-7
39 Washington	-1991	39 Kansas	-635	-19
40 New York	-2188	40 Alabama	-638	-37
41 Florida	-3062	41 Illinois	-954	7
42 Georgia	-3144	42 Arizona	-985	-32
43 Minnesota	-4859	43 Oregon	-1010	-23
44 Connecticut	-5222	44 Colorado	-1187	-11
45 Maryland	-8173	45 Texas	-1659	1
46 Texas	-11136	46 Maryland	-1839	-1
47 California	-11901	47 California	-2130	0
48 Illinois	-14341	48 Florida	-2427	-7
49 New Jersey	-27624	49 New Jersey	-9639	0

Table 2

Negative binomial model results

	GROSS STUDENT FLOWS			
	ALL	HIGH QUALITY	MEDIUM QUALITY	LOW QUALITY
BASIC GRAVITY-VARIABLES				
Distance (Km)	−0.000724***	−0.000519***	−0.000906***	−0.000927***
	2.46E-05	3.87E-05	3.93E-05	3.20E-05
Log(PopOrigin)	0.891***	0.910***	0.990***	0.858***
	0.0298	0.044	0.0475	0.0384
Log(PopDestination)	0.608***	1.074***	0.667***	0.561***
	0.0284	0.0413	0.0504	0.0375
Bordering state (dummy=1)	1.761***	1.098***	1.547***	1.806***
	0.0688	0.0975	0.104	0.086
Same Division (dummy=1)	0.769***	0.467***	0.669***	0.956***
	0.0639	0.0933	0.0991	0.0802
PULL FACTORS (DESTINATION)				
Amenity Rank	0.121***	0.167***	0.112**	0.331***
	0.0322	0.051	0.0552	0.0396
Bordering Ocean (dummy=1)	0.190***	1.206***	−0.813***	0.457***
	0.0427	0.0607	0.0693	0.0551
Employment growth 1993–2007	−0.709*	−12.21***	−3.073***	1.330**
	0.41	0.686	0.654	0.544
Pct with Bachelor	0.0468***	0.0794***	0.109***	−0.0115
	0.00732	0.0111	0.0117	0.00918
Pct foreign born	−0.0351***	−0.0837***	−0.000811	−0.0565***
	0.0082	0.012	0.0129	0.0111
Pct poor	−0.0241***	−0.148***	0.00702	0.00403
	0.00585	0.00869	0.00966	0.0079
Pct undergraduates	3.637***	10.98***	5.599***	0.47
	0.455	0.739	0.739	0.621
Population growth 1993–2007	0.0415	0.734***	0.446***	−0.164*
	0.0718	0.103	0.114	0.0992
Pct selective institutions	2.595***	3.775***	−4.980***	1.693*
	0.756	1.186	1.162	0.895
Pct urban land	0.0104***	0.0167***	0.00206	0.00294
	0.00188	0.00245	0.00317	0.00259
PUSH FACTORS (ORIGIN)				
Amenity Rank	0.136***	0.164***	0.140***	0.0996**
	0.0309	0.0453	0.0484	0.0398
Bordering Ocean (dummy=1)	0.0404	0.121**	0.0347	−0.00447
	0.0428	0.0614	0.0666	0.0552

	GROSS STUDENT FLOWS			
	ALL	HIGH QUALITY	MEDIUM QUALITY	LOW QUALITY
Employment growth 1993–2007	0.0997	–0.399	1.062	0.609
	0.429	0.618	0.677	0.555
Pct with Bachelor	0.0789***	0.0817***	0.0997***	0.0821***
	0.00712	0.0103	0.0113	0.00907
Pct foreign born	0.0349***	0.0125	0.0229*	0.0533***
	0.00865	0.0123	0.0134	0.0111
Pct poor	–0.0632***	–0.0550***	–0.0847***	–0.0633***
	0.00526	0.00796	0.00835	0.00676
Pct undergraduates	1.916***	1.873***	2.350***	1.965***
	0.436	0.641	0.686	0.548
Population growth 1993–2007	–0.075	–0.0787	–0.199*	–0.131
	0.0757	0.112	0.119	0.0978
Pct selective institutions	0.0042	1.294	3.064***	–0.211
	0.749	1.123	1.169	0.95
Pct urban land	–0.00664***	0.000937	–0.0154***	–0.00728***
	0.00201	0.00297	0.00321	0.00259
Constant	–25.01***	–38.63***	–30.46***	–22.05***
	0.999	1.526	1.623	1.321
<i>Observations</i>	<i>2,352</i>	<i>2,352</i>	<i>2,352</i>	<i>2,352</i>
<i>Alpha</i>	<i>–0.383***</i>	<i>0.131***</i>	<i>0.430***</i>	<i>0.0408</i>
	<i>0.0298</i>	<i>0.0385</i>	<i>0.0335</i>	<i>0.0324</i>
<i>Pseudo-R squared</i>	<i>0.1478</i>	<i>0.1748</i>	<i>0.1291</i>	<i>0.1535</i>