

Migration of American College Students

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Abstract

This work studies the migration of college-bound students to attend American colleges and universities in the Fall 2020 timeframe. It makes use of the rich IPEDS data source augmented with additional data to determine both the migration patterns and migration distance for each 4-year institution in the U.S. These results are also used to characterize the movement of college students on a per-state basis.

Using the percentages of college-bound students enrolling in-state as well as first-year students enrolled in colleges of the state, we are able to characterize the college “market” of each state. It shows that Texas, Louisiana and Michigan are the most self-contained markets with both a higher than average percentage of college-bound students remaining in state and a higher than average percentage of first-year college students from in-state. The District of Columbia, Vermont and New Hampshire are freer markets with relatively more student movement in and out of the state. The results suggest that more in-state college capacity is needed for college-bound students in New Jersey and Alaska. Colleges in these markets may also be less attractive as these states both enroll relatively fewer in-state college-bound students as well as out-of-state first-year college students. In contrast, the results suggest that North Dakota, West Virginia and Utah may have more college capacity than is needed. Colleges in these markets may also be more attractive as these states both enroll relatively more in-state college-bound students as well as out-of-state first-year college students.

The migration patterns for major state institutions show Texas A&M and the University of Texas have the highest percentage of first year students from their state while the University of Vermont has the lowest. The University of the District of Columbia and the University of Nevada enroll the highest percentage of in-state or adjoining state students while the University of Michigan, University of Colorado and University of Alabama enroll the smallest percentage in their immediate region. First-year students at the University of Hawaii, University of Oregon, Montana State and the University of Colorado have the highest migration distance to attend these institutions.

Similar migration patterns and migration distance are reported for national public universities, national private universities, national liberal arts colleges, historically black colleges and universities, and primarily online institutions. Focusing on migration distance shows that MIT and Stanford, followed by Cal Tech and Dartmouth, have the greatest reach for national privates. Reed College and Thomas Aquinas College, followed by Pomona College and Wellesley College, have the largest migration distance for the liberal arts colleges with Howard University and Clark Atlanta University having the greatest reach for HBCUs.

The results for primarily online institutions show that Southern New Hampshire University enrolls the highest number of first-year students in this group followed by Grand Canyon University and Liberty University. The results show that the University of Phoenix-Arizona, American InterContinental University and Embry-Riddle Aeronautical University-Worldwide have the greatest reach relative to the location of these institutions.

Finally we examine the initial effects of the Covid-19 pandemic by comparing the Fall 2020 data with previous years. Not surprisingly, these initial pandemic results show a significant increase in the number of fully-online students and a drop in first-year international students. There is more variation among institutional groups. On average, institutions in the HBCU and primarily online groups showed an increase both in the average number of first-year students and the migration distance for these students between 2018 and 2020. In contrast, national liberal arts colleges saw a decline both in the number and migration distance of first-year students. The major state and national public institutions tended to attract more students because of the pandemic, but the students tended to reside closer to the institution.

1 Introduction

This work studies an interesting aspect of the American higher education landscape—the movement of students to attend college. There are many factors that go into the decision process of where American college students choose to attend college. These factors include the immediate location of a college as well as the relative distance between the college and where a student lives. Work such as [6] shows “being far from home” as a factor for college choice, although not a leading one. As part of our own preliminary work [10], we surveyed respondents on factors influencing their college decision and found absolute and relative distance more important for in-state students than for other residential groups. Other work has considered the distance traveled by students for college [2] and looked at distance as a barrier to higher education students [16]. Other interesting work has even looked at the movement of alumni [4].

Building on prior work, we examine the migration of American college students as they move from home to their college of choice. We primarily use Integrated Postsecondary Data System (IPEDS) data, which is compiled annually by the National Center for Education Statistics [7]. It provides extensive data on institutions of higher education. In particular, this dataset provides state residency information for students of colleges and universities in the U.S. These data afford the opportunity to examine the movement within and between states as well as the residence of students attending specific institutions.

Previous work has examined related aspects making use of the same IPEDS data. The most extensive work is longitudinal tracking of the IPEDS location data since 1986[1]. This work reports the import/export of freshman migration by state, grouping states into nine fixed regions of the U.S. The regional makeup of students for specific colleges can also be seen. The website provides numerous visualizations for viewers to explore the data. In our work we also make extensive use of visualizations, but do so around specific research questions we pose and analyze.

Other work has used the IPEDS data to broadly show results for all 2- and 4-year institutions such as percentage of college-bound students from a state attending college in-state using the 2018 data [9]. In contrast, we focus our work on 4-year institutions of each state. Work has examined the extent to which the major public universities of a state serve the students of the state in various ways [11, 8, 5]. In our work we not only study migration patterns and distance for major state institutions, but also look at private institutions and other specific institutional groups.

This work is important because it brings new insight into the movement of students as part of their American college experience. It studies the migration of college-bound students by augmenting the rich IPEDS data source with additional data and new analysis for this important aspect of American society. The work makes a number of contributions.

1. We define the concepts of a migration pattern and a migration distance for the students attending an institution. The migration pattern includes characterization of an immediate region for each state using its set of adjoining states. We then apply these concepts to make direct comparisons of migration patterns and distance on a per-state and per-institution basis.
2. We focus on 4-year institutions in the IPEDS dataset to better compare similar types of institutions. Even more specifically, we make comparisons within institutional peer groups.
3. We examine the college ecosystem for each state comparing where college-bound students of the state go to attend college and where first-year students of colleges in the state are from.

We use these results to characterize different types of state markets for colleges.

4. We distinguish between the public and private institutions of a state and examine how well each set does in retaining the college-bound students from the state.
5. We identify the most common migration paths where students from a specific state attend a particular institution.
6. We characterize a set of primarily online institutions and examine how the migration patterns and distance for these institutions compare with traditional in-person institutions.
7. We use longitudinal data to examine the initial impact of the Covid-19 pandemic on the migration of American college students.

In the remainder of this report we pose a set of research questions in Section 2 and describe the methodology we employ to answer these questions in Section 3. Section 4 presents results of our analysis on a per-state basis. The next two sections present results on migration paths as well as migration patterns and distances for specific institutions. Section 7 examines the impact of the Covid-19 pandemic on migration of college students. We conclude the report in Section 8 with a summary of our results and directions for future work.

2 Research Questions

The motivation of our work is to understand the movement of college-bound students to American colleges and universities. We look to examine the migration of students at both the state and institutional level. This motivation leads to a number of specific research questions that drive our work, which are enumerated below.

1. **For each state, how does the number of college-bound students retained by in-state colleges compare with the number of students entering and leaving the state for college?** This question allows us to characterize states in terms of whether they export more or less of their college-bound students as well as whether their colleges import more or less of first-year college students.
2. **What percentage of state college-bound students are retained by public and private colleges in the state?** Answers to this question separate out results for the public college system and the set of private institutions for each state in attracting the state's college-bound students. The answers help us to understand how well each state does in retaining its own college-bound students.
3. **What are the migration patterns of college-bound students moving between states for college?** This research question contains many sub-questions such as how many of these students attend college at an institution in the immediate region of their home state and how many attend college in other states? What is the distance from home for college-bound students of a state to attend college? How many international students are attracted to the colleges of a state?

4. **What public, private and out-of-state institutions enroll the most college-bound students from each state?** Rather than consider all enrollments, we work to identify the most pronounced migration paths for college-bound students of specific states to particular institutions.
5. **What are the migration patterns and distances of first-year students attending for different institutional groups?** Are the students from the same state as the institution, an adjoining state in the immediate region, elsewhere in the U.S., or international? How far is the home of these students from the institution as a measure of reach for each institution? We seek to answer these questions for institutions in a variety of peer groups including major state public institutions, national private institutions, national liberal arts colleges, historically black college and universities, and primarily online institutions.
6. **What is the impact of the Covid-19 pandemic on the migration of college students?** We found in our initial work that students who made their college decision during the pandemic found relative distance more important than students doing so at other times [10]. To the extent that available data afford, we seek to examine the impact of the pandemic on the number of enrolled students, their distance between home and school, the enrollment of international students and percentage of those students attending online.

3 Methodology

In this section we describe the methodology to answer these questions. We describe the data employed as well as approaches taken in analyzing them.

3.1 Student Residency Data

The primary data used for our work are the publicly-available Integrated Postsecondary Data System (IPEDS) [7]. Its website provides a wealth of data for institutions of higher education in the U.S. These data are provided by the institutions themselves on an annual basis with the website allowing for retrieval of selected institutional information.

In particular, we make use of IPEDS data of each institution with the number of “first-time degree/certificate-seeking undergraduate students” from each state and the District of Columbia (treated as the 51st “state” in our study). Based on [1] these data are required for institutions to report in even-numbered years, although many institutions also report the data in odd-numbered years. The data do include the number of students from foreign countries, but do not provide counts for specific countries. We use these per-state residence counts as the basis of our work to study migration patterns of American college students.

We augment these residence counts with additional data from IPEDS and other sources to study migration patterns for first-year students enrolling in institutions. We initially used IPEDS data for students enrolling in Fall’18 [10], but for this work were able to obtain and use more recent data for first-year students enrolling in Fall’20. Unless otherwise noted, data from this year are the source for all results reported in this work.

We focus our analysis on public and non-profit private 4-year institutions. The IPEDS dataset for students entering college in Fall’20 contains 1724 such institutions. 1619 of these institutions

provided state residence data for their first-year students with residence data recovered from Fall'18 or Fall'19 for 51 additional institutions resulting in a total of 1670 institutions used in our study. These institutions provided known residency information (state or international) for 99.3% of their first-year students, which is an extensive knowledge base.

3.2 Migration Pattern Characterization

In analyzing the number of students from each state for an institution, we determine the number of in-state students based on the students' state matching the institution's state. However the data do not indicate whether the out-of-state students are from the immediate region or from farther away.

As a means to overcome this limitation, we chose not to divide states into fixed regions, but rather use self-defining regions for each state via its set of adjoining states. This set of states defines the "immediate region" for a state. The size of that region varies with Alaska and Hawaii having no adjoining states while Missouri and Tennessee each having eight. Based on U.S. geographical connectivity results [15], we do extend the concept of "adjoining" for a small number of state combinations where there is influence between the states despite them not explicitly sharing a border. These augmented pairs are DC/PA, PA/VA, KS/TX, MA/ME and MT/WA.

With the introduction of the adjoining states concept, we are able to define categories of student migration. We characterize the first-year students attending an institution into four categories: 1) from the same state as the institution; 2) from an adjoining state; 3) from another U.S. state; or 4) from outside of the U.S. Similarly we are able to characterize the college-bound students from a state into three categories: 1) attend an in-state institution; 2) attend an institution in an adjoining state; or 3) attend an institution in another U.S. state. Note the data we obtained do not provide counts on the number of college-bound students from a state attending international institutions nor first-year college students from U.S. territories.

3.3 Migration Distance Estimation

While the migration pattern characterization based on a student's state of residence and of the institution attended are interesting, we introduce another approach for summarizing the migration pattern of college-bound students from a state and first-year students of an institution. This summary result is based on estimating the average migration distance between each student's home and the institution that the student attends. A similar metric of average distance traveled by students of a college was previously presented in [2], but details of how the metric was computed are not given and results are provided for only the top-25 ranked colleges.

This approach is appealing because it combines the three separate percentages (in-state, adjoining states and other U.S. states) into a single value. Institutions with a high percentage of in-state students will tend towards a lower migration distance and institutions with a high percentage of students outside of the immediate region will tend towards a higher migration distance. This average distance gives an indication of the "reach" of an institution in the students it attracts and allows for direct comparison of institutions. It does not take into account international students since location data for these students are not available in the dataset.

Ideally we would compute average distance between home and school address for each student. A challenge is that the data do not provide this level of detail, but instead we only know the number of students from each state attending an institution. Despite this challenge, we are able to

make reasonable assumptions allowing the migration distance for each institution to be estimated. Specifically:

- We assign a migration distance of zero for all students attending an institution in the same state as their home. While all such in-state students will have a non-zero migration distance (potentially much distance in geographically larger states), it reflects that these students have stayed within their state for college.
- For a student where their home is not in the same state as that of their institution, we use the center of population of the student’s home state as the approximate location. The U.S. Census Bureau provides these centers of population for each state [12]. We then determine distance (in miles) between the latitude/longitude coordinate of the institution and the coordinate of the state’s population center.
- We make use of these two assumptions for in-state and out-of-state students to calculate a weighted sum and then divide by the total number of students to obtain the average migration distance.

3.4 Institutional Groups

While interesting to be able to analyze the migration patterns and migration distance for all 1670 institutions in our study, being able to make meaningful institutional comparisons is difficult. Rather we focus on making comparisons for groups of institutions with similar characteristics. There are many such approaches for grouping institutions and the ones we choose to highlight are only a small number. However these comparisons provide insights across a range of institutional groups and could be extended to other identifiable groups.

The institutional groups that we do analyze in this work and how they were determined:

1. **Major State Institutions.** A common college peer group for comparison is the set of public flagship institutions for each state. However there is not an official definition for such a group. Moreover, states may also have land-grant universities based on the Morrill Act of 1862 [3]. Finally there are major public institutions, such as Arizona State University or Florida State University, that are neither a flagship nor a land-grant institution in their state. Therefore, we define our own “major state institution” group consisting of 78 public institutions including flagship, land-grant and a half dozen other major state institutions. We ensure each state has at least one such institution and no state has more than two.
2. **National Public Universities.** Our second institutional group overlaps with the first group, but drops the limitations that all states must have at least one institution and no state may have more than two. The group membership consists of the 77 public institutions in the top-150 (plus ties) U.S. News Best National University rankings [14].
3. **National Private Universities.** The membership of this group consists of the 84 private institutions in the top-150 (plus ties) U.S. News Best National University rankings [14].
4. **National Liberal Arts Colleges.** This group includes the 78 institutions ranked in the top-75 (plus ties) national liberal arts college rankings by the U.S. News [13]. This group largely consists of private institutions, but does include a few public institutions.

5. **Historically Black Colleges and Universities.** This group includes 4-year institutions marked as “Historically Black College or University” in the IPEDS dataset. For focus, we only consider the largest 51 (out of 81) institutions in this group that have at least 250 first-year students. The resulting group consists of both public and private institutions.
6. **Primarily Online Institutions.** For this group, we not only consider public and private institutions, but also include for-profit institutions. The membership of this group is based on IPEDS data reporting the number of “Students enrolled exclusively in distance education courses” relative to “All students enrolled.” We use the 2019 IPEDS data for this determination to avoid potential pandemic effects and include 27 institutions with at least 50% for this ratio. Some of these institutions are branches of traditional public universities such as Arizona State Digital Immersion or Purdue University Global while others have a mix of on-campus and online students such as privates Southern New Hampshire University and Liberty University, and the for-profit Grand Canyon University.

4 Migration of College Students on a Per-State Basis

We use the various data sources and described methodology to investigate the research questions identified in Section 2. This section shows results done on a per-state basis. Subsequent sections show results on a per-institution basis.

4.1 College-Bound Students Attending In-State Colleges and First-Year Colleges Students from In-State

For this research question, we first examine how the number of college-bound students exported from a state compares with the number of first-year students imported from elsewhere to colleges within the state. The import/export results are summarized in the scatter plot of Figure 1. The diagonal line represents equal numbers of college-bound students imported and exported. States above the diagonal import more college students than they export and states below the diagonal export more college students than they import. More states are shown above the diagonal because import numbers include first-year college students from outside of the U.S. while export numbers only include the number of college-bound students to U.S. colleges.

The top of Figure 1 shows that colleges in New York, Pennsylvania and Massachusetts import the most out-of-state college students. The right side of the figure shows that California, New Jersey and Illinois export the most college-bound students to other states.

The figure shows that Pennsylvania, New Hampshire and Indiana have the largest net inflow of students when comparing student import and export counts. Graphically these are the three states furthest above the diagonal in the figure. In contrast, New Jersey, Illinois and Texas have the largest net outflow of college-bound students and are the furthest below the diagonal line.

While the college-bound import/export state counts are interesting they do not take into account the number of college-bound students who remain in state to attend college. As a means to account for in-state numbers and to normalize based on total counts for each state, we determine the percentage of college-bound students attending in-state colleges and the percentage of first-year college students from in-state. These two results for each state are shown in the scatter plot of

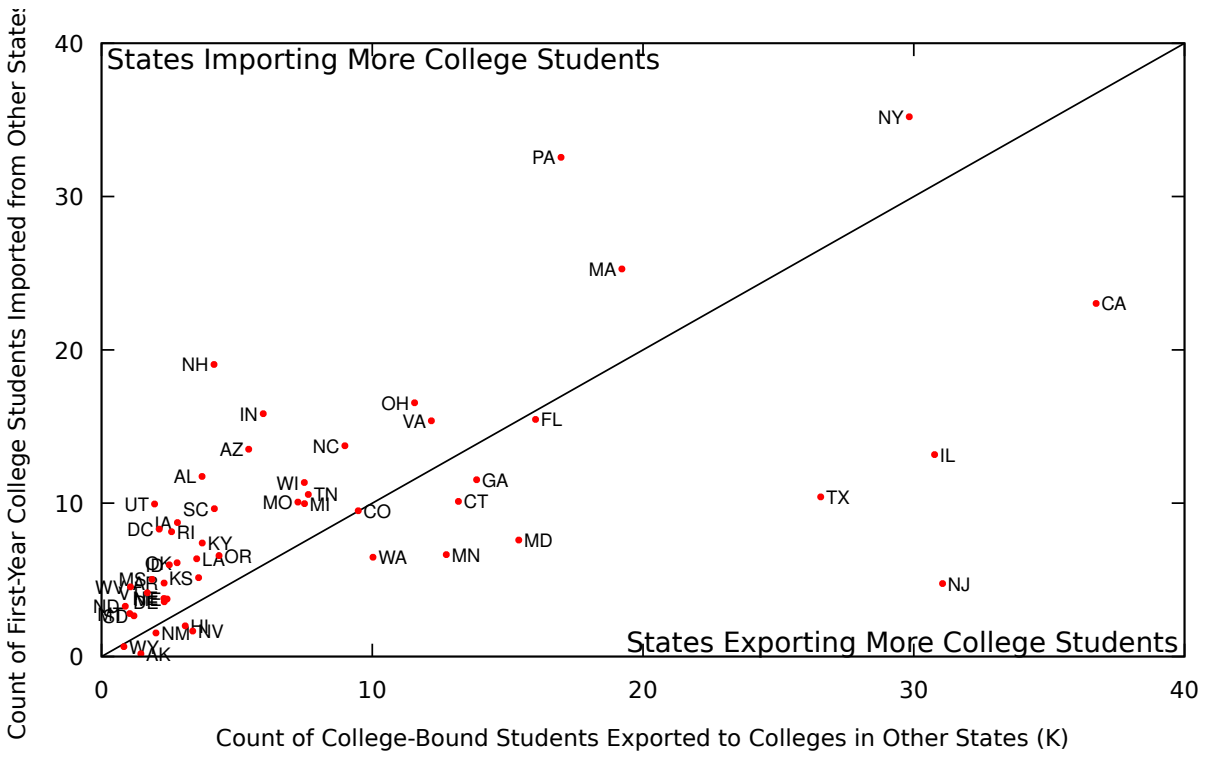


Figure 1: State Counts of Exported College-Bound Students Compared with Imported First-Year College Students

Figure 2. The plot is divided into four quadrants by adding lines on each axis showing that overall 69% of college-bound students enroll in in-state colleges.

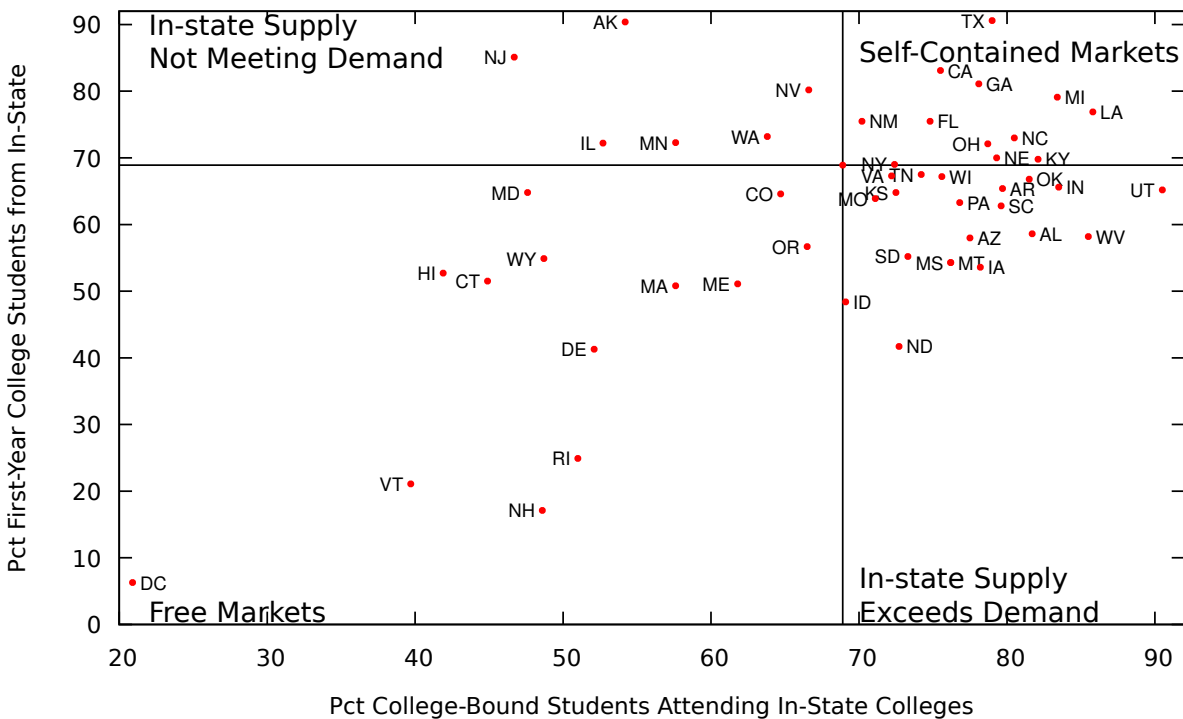


Figure 2: Pct. In-State College-Bound Students Attending In-State Colleges and First-Year College Students from In-State

The quadrants characterize a range of “markets” for how the percentage of college-bound students retained at in-state colleges compares with the percentage of first-year college students from the state. As labeled on the graph, these four quadrants can be characterized as follows:

1. **Self-Contained Markets.** These states shown in the upper-right quadrant of the graph are relatively self-contained markets in which a higher than average percentage of college-bound students remain in-state and a higher than average percentage of first-year college students are from in-state. Texas, Louisiana and Michigan are the most notable states in this category where both demand by college-bound students and for first-year students of colleges is being satisfied from the state itself. These state markets are more self-contained as there tends to be less movement of college-bound students in and out of state.
2. **Free Markets.** These states shown in the lower-left quadrant of the graph are relatively free markets in which a lower than average percentage of college-bound students remain in-state and a lower than average percentage of first-year college students are from in-state. The District of Columbia, Vermont and New Hampshire are the most notable states in this category where more demand by college-bound students and for first-year students of colleges is being satisfied from out-of-state. These state markets are freer as there tends to be much movement of college-bound students in and out of state.

3. **In-state Supply Not Meeting Demand.** These states shown in the upper-left quadrant of the graph have a lower than average percentage of college-bound students remaining in-state, but a higher than average percentage of first-year college students are from in-state. New Jersey and Alaska are the most notable states in this category where in-state colleges are being relatively filled with in-state students, yet there is still a considerable percentage of in-state college-bound students who are attending out-of-state colleges. These markets suggest more in-state capacity is needed for college-bound students. Colleges in these markets may also be less attractive as these states both enroll relatively fewer in-state college-bound students as well as out-of-state first-year college students.
4. **In-state Supply Exceeds Demand.** These states shown in the lower-right quadrant of the graph have a higher than average percentage of college-bound students remaining in-state, but a lower than average percentage of first-year college students are from in-state. North Dakota, West Virginia and Utah are the most notable states in this category where in-state colleges are not being filled with in-state students, yet there is still a considerable percentage of in-state college-bound students who are attending in-state colleges. These results suggest more in-state capacity is available than is actually needed for college-bound students. Colleges in these markets may also be more attractive as these states both enroll relatively more in-state college-bound students as well as out-of-state first-year college students.

4.2 Retention of College-Bound Students by In-State Public and Private Colleges

Figure 2 shows the percentage of college-bound students attending in-state colleges, but it does not separate out whether these students are attending public or private colleges in the state. For this research question we consider such a distinction.

Figure 3 shows a scatter plot for the results of this analysis where the percentage of college-bound students attending in-state public colleges is shown on the x-axis and the percentage of college-bound students attending in-state private colleges is shown on the y-axis. We divide the plot into four quadrants with a vertical line at the average (54%) of all college-bound students attending an in-state public college and a horizontal line at the average (15%) of all college-bound students attending an in-state private college.

The left-side of the plot shows that only 12% of college-bound students in the District of Columbia attend a public college in the district. New Hampshire (27%), Illinois (29%) and Vermont (30%) are next lowest in retaining their own college-bound students in public colleges. At the other extreme, 80% of college-bound students in Utah attend a public college in the state with students in Louisiana (80%) and West Virginia (79%) the next highest. The top of the plot shows that 30% of college-bound students from New York attend an in-state private institution while 26% from Massachusetts and 25% from Pennsylvania do so. In contrast, fewer than 1% of college-bound students from Wyoming, Nevada, Alaska and New Mexico attend in-state private institutions.

The upper-right quadrant in the plot shows states that have both relatively high in-state public and private enrollment by their college-bound students with Indiana and Kentucky the most notable in this respect. The lower-left quadrant shows the District of Columbia followed by Vermont

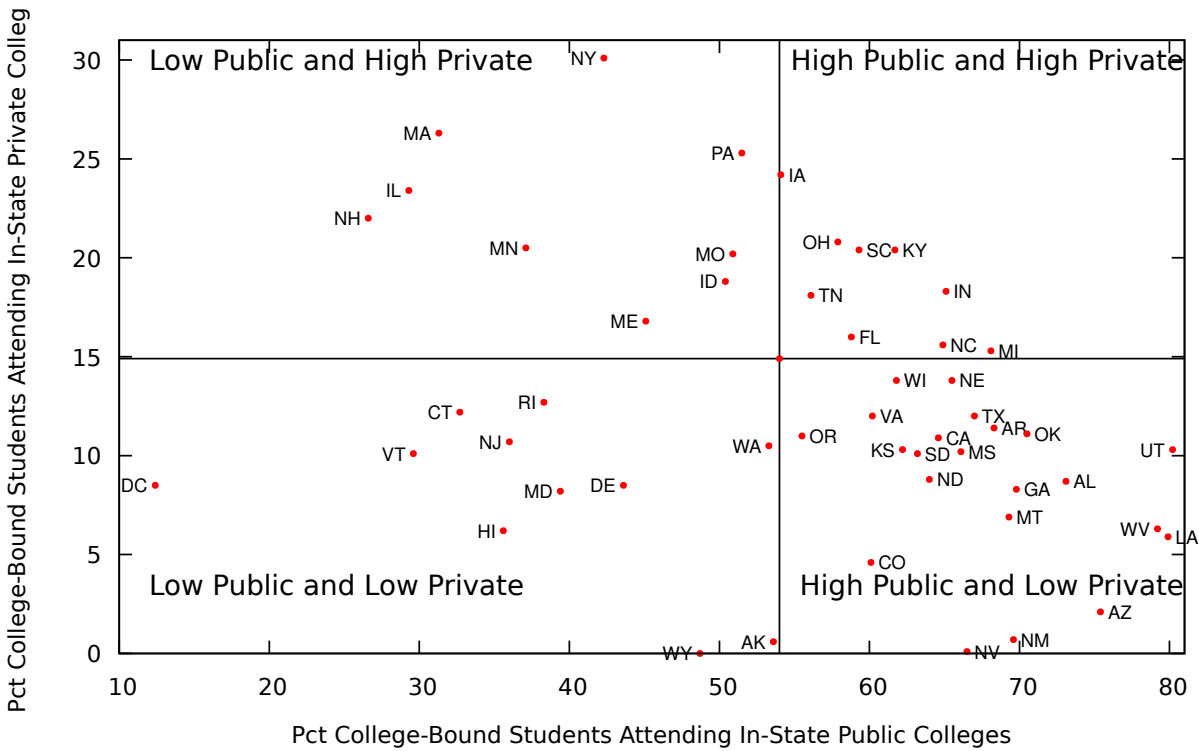


Figure 3: Pct. College-Bound Students Attending In-State Public and Private Colleges

and Hawaii as the most notable states for both low public and private college enrollment by in-state college-bound students. The upper-left quadrant shows states with relatively low in-state public college enrollment and relatively high in-state private college enrollment. New Hampshire, Massachusetts and Illinois are the most notable in this respect. Finally, the lower-right quadrant shows Arizona, Louisiana and West Virginia as the most notable states for relatively high in-state public college enrollment, but low in-state private college enrollment.

4.3 Migration Patterns and Distance for College Students on Per-State Basis

Our initial research results focus on whether or not college-bound students are attending in-state colleges and first-year students of a college are from in-state. We next examine the movement of college-bound students between states in more detail. In this analysis for each state, we examine migration patterns by dividing the remaining set of states into those that are adjoining, as described in Section 3, and all other U.S. states. We go on to determine the migration distances of college-bound students from a state as well as for first-year students to colleges in the state.

4.3.1 Movement of College-Bound Students from a State

We first examine the movement of college-bound students from a state. The x-axis of Figure 2 shows the percentage of college-bound students that remain in-state for college with the District of Columbia having the lowest such percentage at 21% and Utah having the highest percentage with

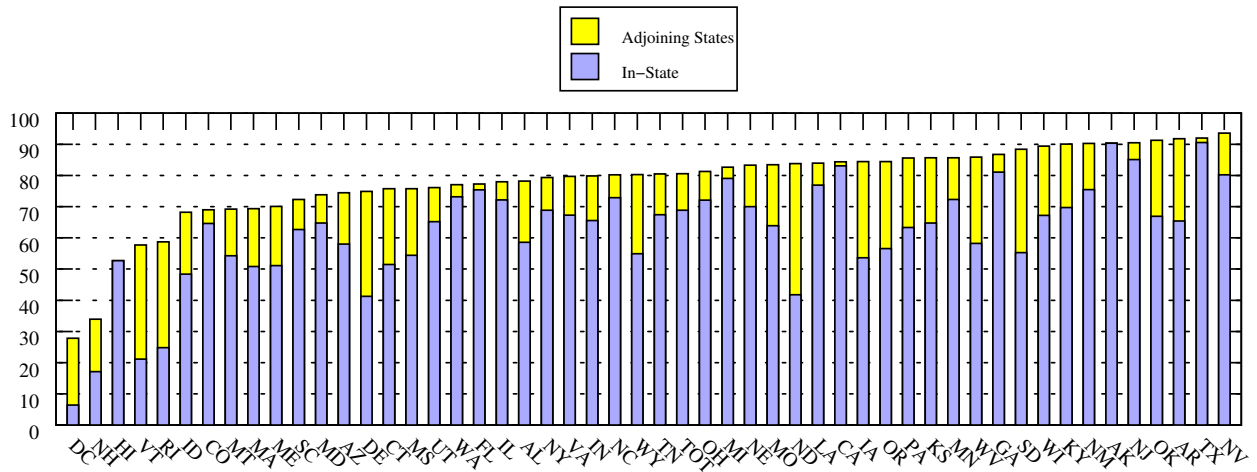


Figure 5: Pct. First-Year College Students from In-State and Adjoining States

The left-hand side of Figure 5 show that the District of Columbia, New Hampshire and Hawaii have the lowest percentages of first-year college students from the immediate region of the state.

Figure 6 adds another set of data to show an ordered list of states based on the total percentage of first-year college students in each state from the U.S. The right-hand side of the figure show that over 99% of the first-year students for institutions in Montana, Mississippi and Nevada are from the U.S.

In contrast, the left-hand side of the figure shows the states with the lowest percentage of first-year college students from the U.S. Implicit in these results is that Massachusetts (8%), the District of Columbia (6%), California (6%), New York (6%) and Hawaii (6%) have the highest percentage of first-year international students attending institutions in the state.

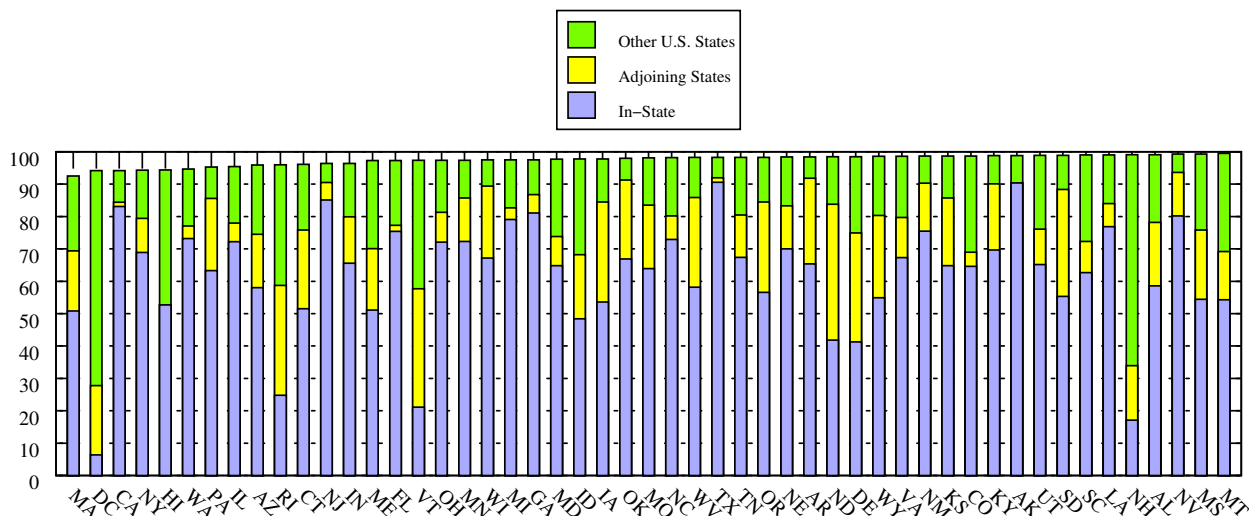


Figure 6: Pct. First-Year College Students from In-State, Adjoining States and Other U.S. States

As a means to summarize the migration pattern results shown in Figures 4 and 6 for college-

bound students from a state and first-year students of colleges in a state, Figure 7 shows a scatter plot with the migration distance (computed as described in Section 3) for each result. We divide the plot into four quadrants based on the average migration distance of 186 miles for all students.

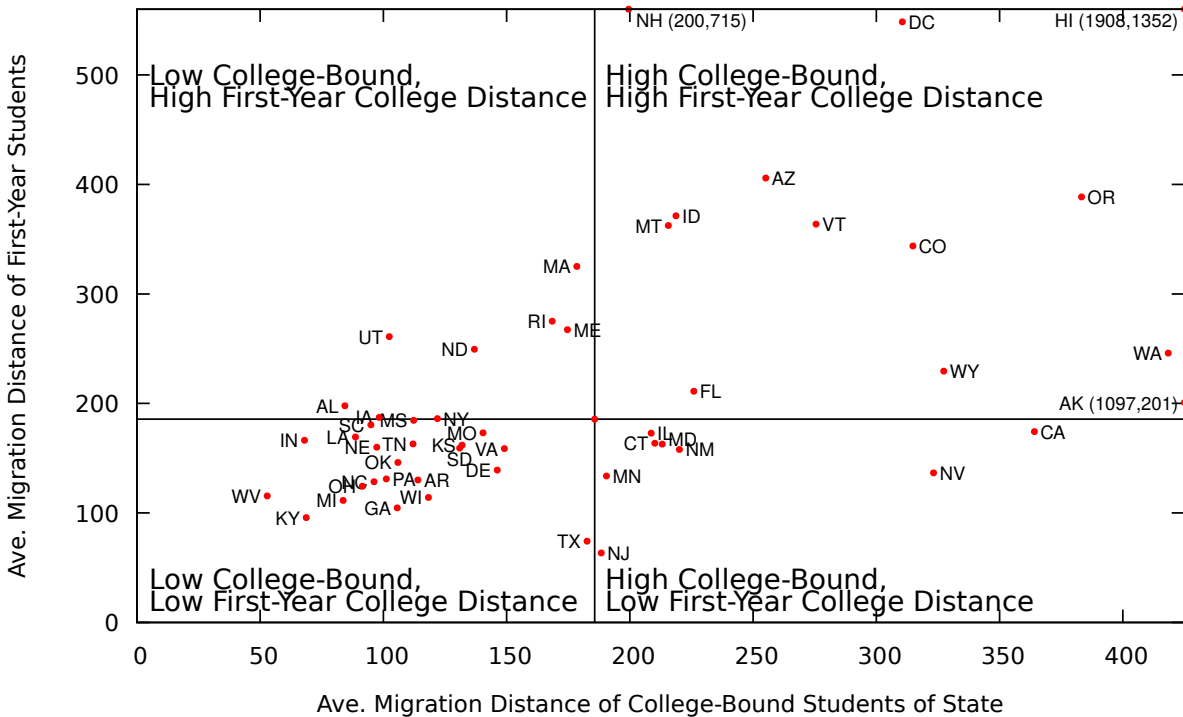


Figure 7: Migration Distance (Miles) for College-Bound Students of State and First-Year Students of Colleges in State

The top of the graph shows that first-year students for colleges in Hawaii, New Hampshire and the District of Columbia have the largest estimated distance between home and school. The bottom of the graph shows that first-year students for colleges in New Jersey and Texas have the smallest distance between home and school.

The right side of the graph shows college-bound students from Hawaii and Alaska attend college furthest from home with Oregon and California students next furthest. The left side of the graph shows that West Virginia students attend college closest to home with Indiana and Kentucky students next closest.

The four quadrants further characterize the migration distance of college-bound students from a state and first-year college students in colleges of the state. The upper-right quadrant shows states in which the migration distance of their college-bound and first-year college students are high. In particular, Hawaii, District of Columbia and Oregon are the most notable in this quadrant. In contrast, the lower-left quadrant shows states that are relatively lower for each of these migration distances. Kentucky and West Virginia are the most notable for both in-state college-bound students staying close to home and in-state colleges attracting nearby first-year students.

The lower-right quadrant shows that California and Nevada are the most notable states for a relatively high migration distance for their college-bound students, but a relatively lower migra-

tion distance for first-year college students of the state. The upper-left quadrant has the opposite characteristics where Utah is the most notable state for a lower-than-average migration distance for college-bound students, but a higher-than-average distance for first-year students of its colleges.

5 Migration Paths from Specific States to Institutions

The next phase of our study examines the institutions that enroll the most college-bound students from a specific state. These institutions are typically in the home state of the student, but some institutions attract a significant number of students from out-of-state. In the following we summarize our results by showing the top-20 institutions for attracting the largest number and highest percentage of college-bound students from a single state. We include results for public, private and out-of-state institutions.

5.1 Top Public Institutions for College-Bound Students from a Single State

Figure 8 shows the top-20 public institutions for the highest number of college-bound students from a single state. The “ST→Institution” path notation indicates the state and the institution in which this number of students has enrolled. In this and subsequent graphs we use shortened institution names to increase readability.

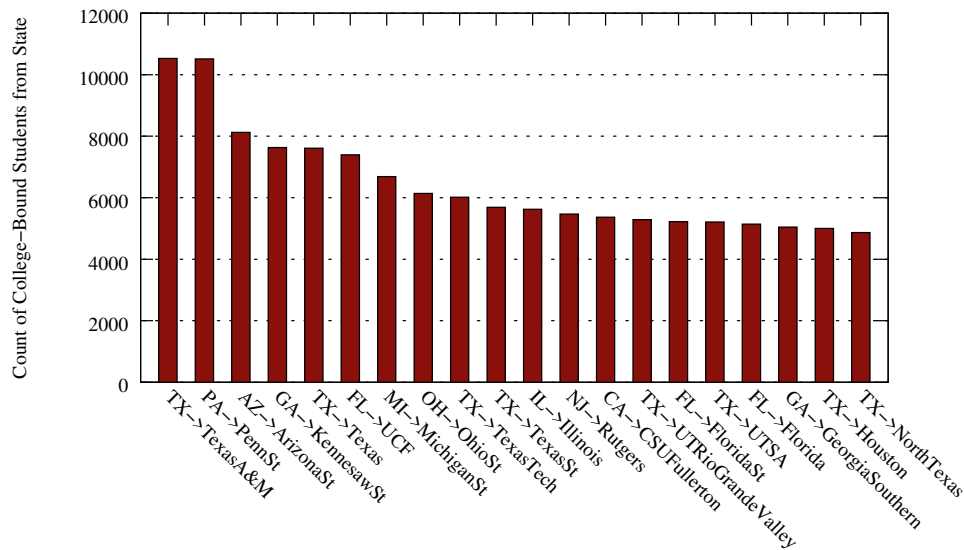


Figure 8: Top-20 Institutions for Number of Enrolled In-State College-Bound Students

Not surprisingly, all top-20 results are cases where the students are from the same state as the institution. The results show that Texas A&M and Penn State are the top-two institutions with over 10000 in-state students enrolled. Arizona State enrolled the third-most number of in-state students. The results show that eight Texas and three Florida institutions are included in the top-20 in terms of number of enrolled in-state students.

Figure 9 shows the same results for the top-20 public institutions except it is based upon the percentage of college-bound students enrolled from a state. These results are significantly different as they highlight that 49% of college-bound students from Wyoming enroll at the University of Wyoming. Over 35% of college-bound students from Nevada and Delaware enroll at UNLV and the University of Delaware, respectively. The states of Nevada, New Mexico and North Dakota each have their two major state institutions in the top-20.

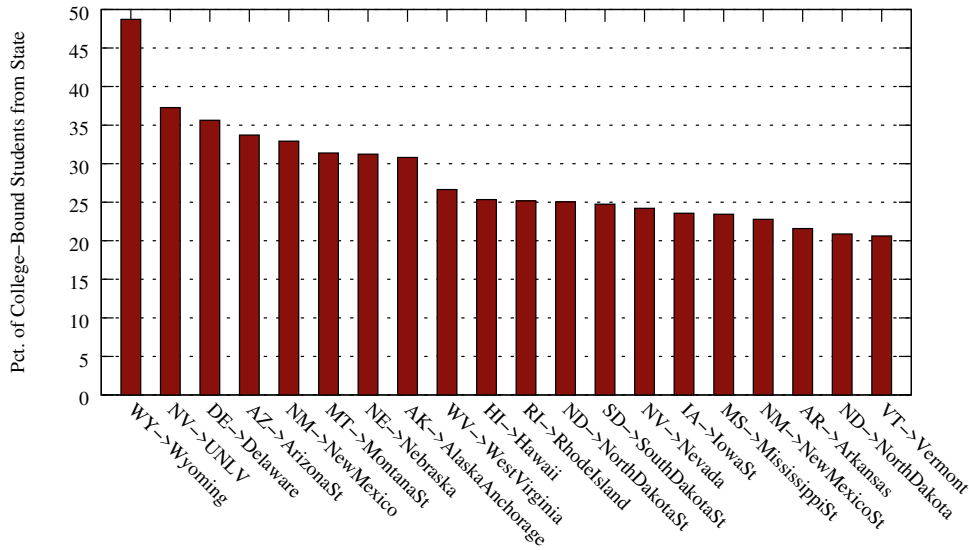


Figure 9: Top-20 Institutions for Pct. of Enrolled In-State College-Bound Students

5.2 Top Private Institutions for College-Bound Students from a Single State

We next examine the top-20 set of private institutions for college-bound students enrolled from a single state. Figure 10 shows the top-20 private institutions for the highest number of college-bound students from a single state. It shows most students are from the same state as the institution, but the scale of these results is much lower than Figure 8 with only Baylor University and BYU having more than 2000 college-bound students enrolled from their state.

Five institutions from the state of New York are in the top-20. It is notable that the private primarily online institutions of Liberty University and Southern New Hampshire University appear in four top-20 migration paths.

Figure 11 shows the top-20 private institutions for the highest percentage of college-bound students from a single state. In particular, Southern New Hampshire University enrolls over 15% of college-bound students in New Hampshire and BYU-Idaho enrolls over 14% of such students in Idaho. The results show that SNHU is in the top-20 for percentage of college-bound students from three separate states and BYU for two states.

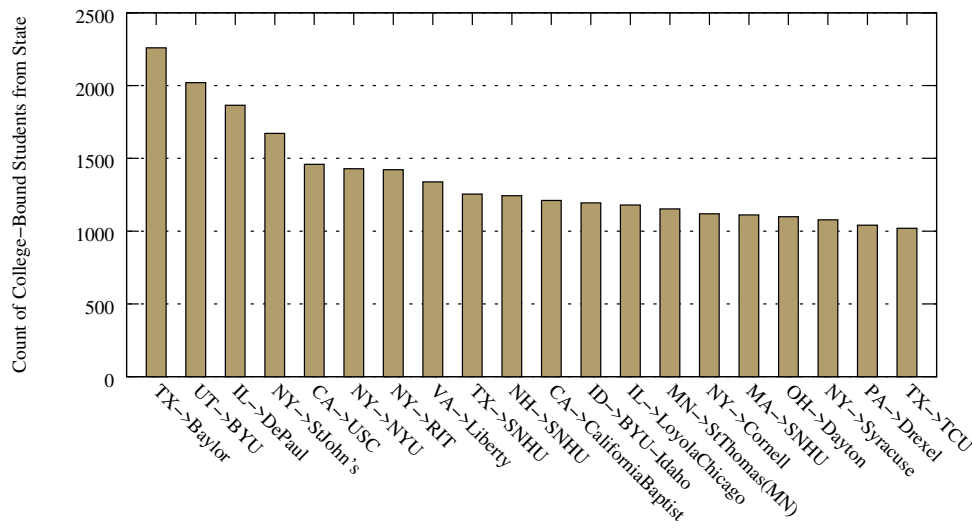


Figure 10: Top-20 Private Institutions for Number of Enrolled College-Bound Students from a State

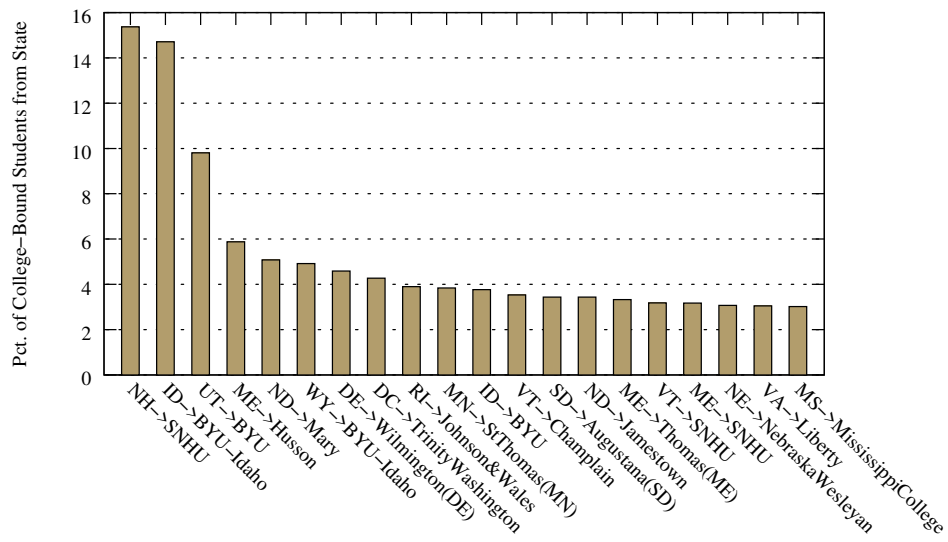


Figure 11: Top-20 Private Institutions for Pct. of Enrolled College-Bound Students from a State

5.3 Top Institutions for Out-of-State College-Bound Students

Figure 12 shows the set of institutions that enroll the most out-of-state students from a single state. It shows that Texas sends the most students out-of-state to the University of Oklahoma and the University of Arkansas. North Dakota State is third-most in enrolling students from Minnesota. The top-20 institutions are all public except for four paths involving Southern New Hampshire University.

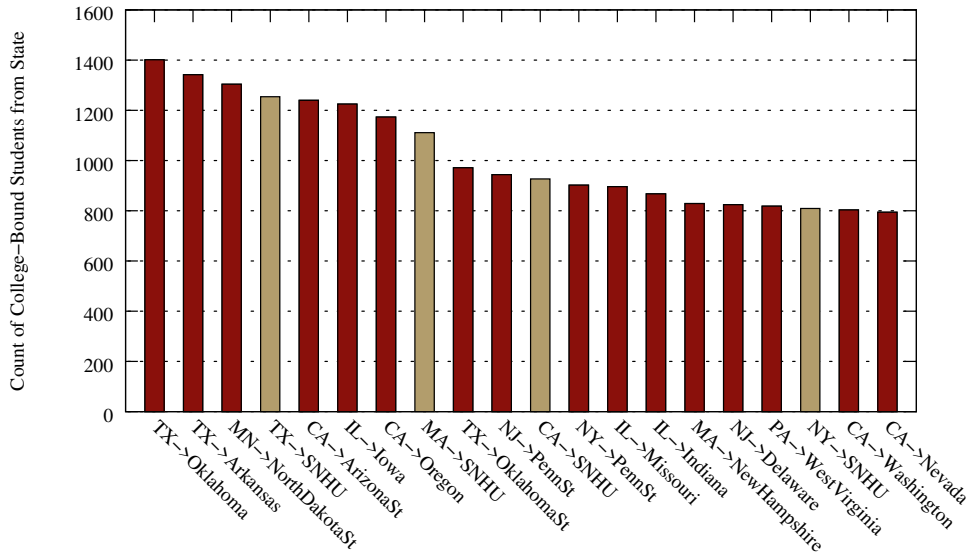


Figure 12: Top-20 Institutions for Number of Enrolled Out-of-State College-Bound Students

College-bound students from California each enroll in five separate out-of-state top-20 institutions. Texas, Illinois, New York, New Jersey and Massachusetts also have students going to multiple out-of-state institutions in the top-20.

Figure 13 shows the set of institutions that enroll the highest percentage of out-of-state students from a single state. These institutions are mostly public, but include a few privates. It shows over 5% of North Dakota college-bound students enrolling at Minnesota State Moorhead with just under 5% of Idaho students enrolling at Utah State and Wyoming students at BYU-Idaho.

By percentage, college-bound Wyoming and Minnesota students enroll in three out-of-state institutions in high numbers. New Mexico, North Dakota and Idaho students each attend multiple out-of-state institutions in the top-20. SNHU enrolls a high percentage of out-of-state, college-bound students from four states. Interestingly, a relatively high percentage of Wisconsin college-bound students go out of state to attend the University of Minnesota and the same for Minnesota students attending the University of Wisconsin.

6 Student Migration Patterns and Distance for Institution Groups

The next phase of our study examines results for the migration patterns of first-year students attending specific institutions. For each institution, we examine whether students are from the same

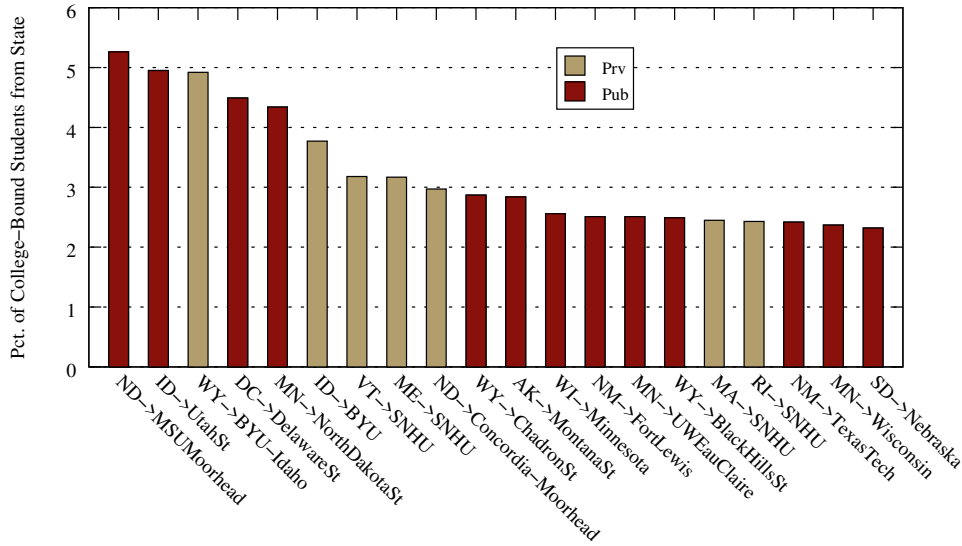


Figure 13: Top-20 Institutions for Pct. of Enrolled Out-of-State College-Bound Students

state as the institution, from an adjoining state, from another U.S. state or are from outside of the U.S. We also summarize the first three of these categories by computing a migration distance, described in Section 3, as an estimate of the average distance between home and school for each first-year student.

We report these migration results for institutions by presenting them in identifiable peer groups. The use of peer groups allow results to be compared for institutions of similar type. Rather than report results for each institution within a peer group, we instead show only the 20 highest and lowest ranked institutions in each case. This approach allows us to focus attention on the most notable institutions in each group.

6.1 Major State Institutions

We first examine immigration results for 78 major state (all public) institutions. We have defined this peer group to consist of flagship, land-grant and a half dozen other major state institutions where each state has at least one such institution and no state has more than two.

Figure 14 shows the 20 highest and lowest ranked institutions in this group based on the percentage of first-year students from the same state as the institution. The “middle” 38 institutions are not shown in the graph (and subsequent graphs) to focus attention on the most notable institutions for this metric.

The right-side of the figure shows that Texas A&M and the University of Texas are the only two major public institutions where over 90% of first-year students are from the state of the institution. Stony Brook University ranks third in this respect. The left-side of the figure shows that only 24% of first-year students from the University of Vermont are from the state. North Dakota State is ranked next lowest with 35% of first-year in-state students and the University of Rhode Island is third-lowest at 40%.

Figure 15 ranks the same set of institutions based on the percentage of first-year students from

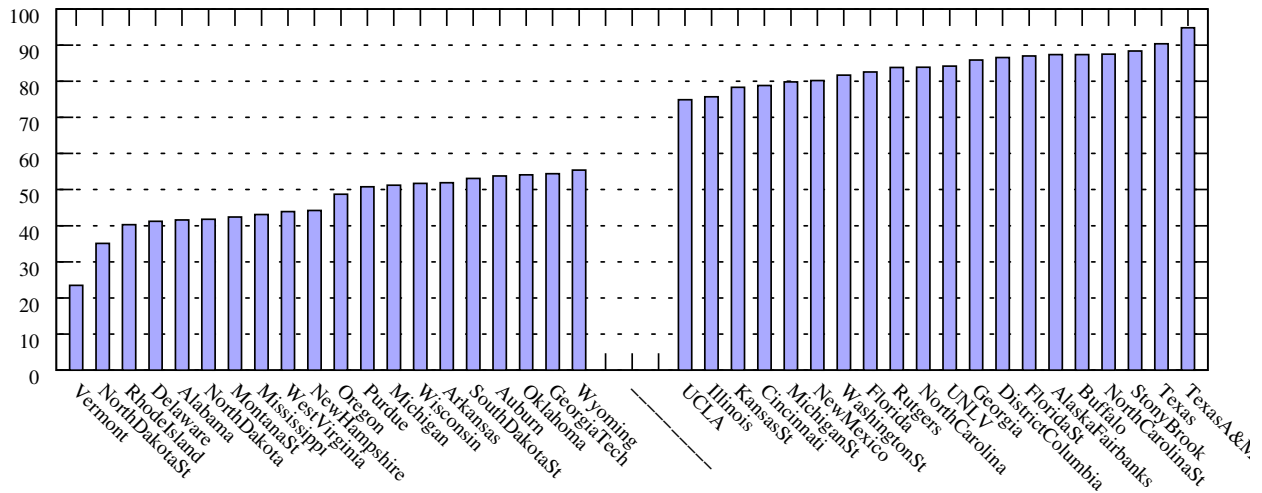


Figure 14: 20 Highest and Lowest Ranked Major State Institutions for Pct. of First-Year Students from In-State

the state or adjoining state of the institution. The University of the District of Columbia ranks the highest for this metric with 98% of first-year students from the immediate region. The University of Nevada is second highest and Texas A&M third highest. Interestingly, North Dakota State ranks the third lowest in Figure 14 for in-state first-year students, but is fourth highest in Figure 15 for attracting in-state and adjoining state students.

The lowest-ranked institutions in Figure 15 are different than those in Figure 14 with the University of Michigan attracting only 55% of its first-year students from the state of Michigan or adjoining states. The University of Colorado is ranked second lowest at 57% and the University of Alabama is ranked third lowest at 59% for first-year students from their immediate region.

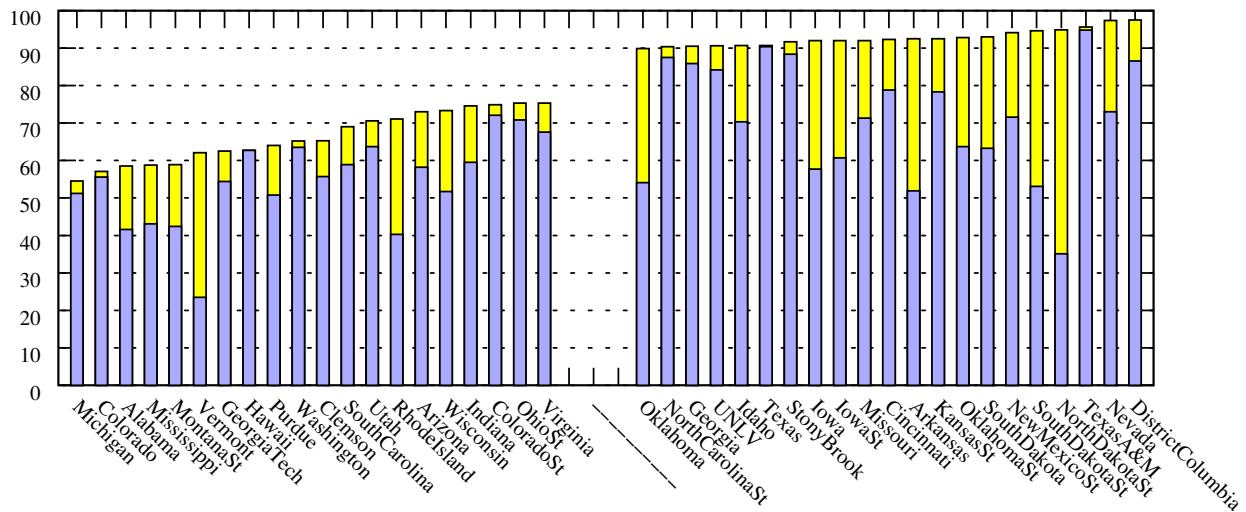


Figure 15: 20 Highest and Lowest Ranked Major State Institutions for Pct. of First-Year Students from In-State and Adjoining States

Figure 16 ranks institutions based on the percentage of first-year students from in-state, adjoining states and other U.S. states. The right side of the figure shows most of the 29 institutions that enroll over 99% of their first-year students from the U.S. The left side of Figure 16 is more interesting showing that only 85% of first-year students at the University of Washington are from the U.S. The University of California is next lowest at 87% and the University of Illinois is third-lowest at 88%. Implicitly shown in the figure is that these institutions with relatively lower domestic enrollments have relatively higher first-year enrollments from international students. Thus the University of Washington enrolls 15% of its first-year students from outside of the U.S. The University at Buffalo is interesting in that Figure 14 shows it ranks fifth highest in the percentage of in-state first-year students while Figure 16 shows that it also ranks fifth highest in the percentage of international first-year students.

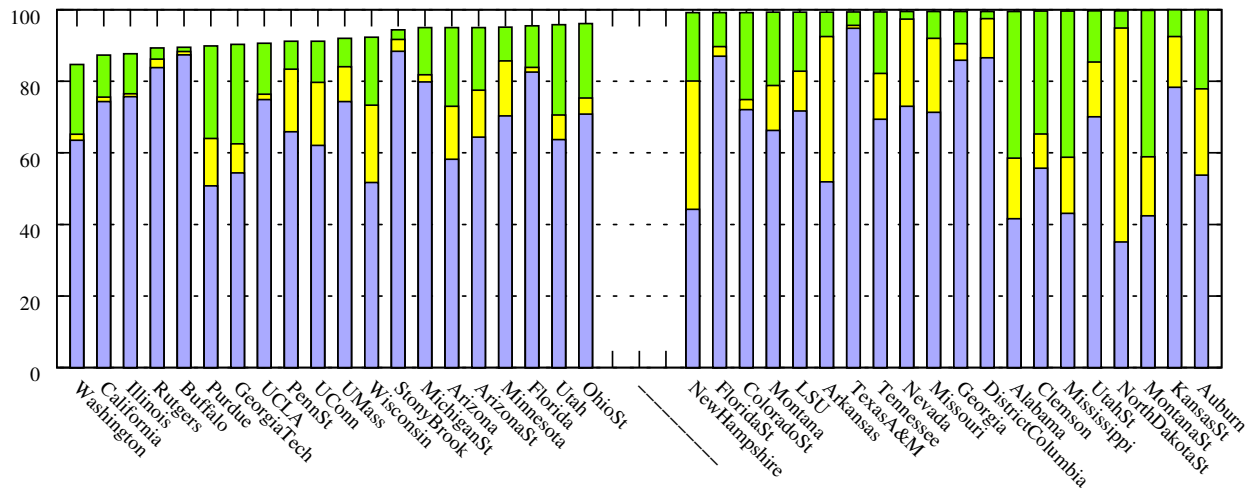


Figure 16: 20 Highest and Lowest Ranked Major State Institutions for Pct. of First-Year Students from In-State, Adjoining States and Other U.S. States

Figure 17 summarizes the results in Figure 16 to show the 20 highest and lowest ranked major public state institutions based on the migration distance of first-year students from the U.S. Given its distance from the U.S. mainland, it is not surprising that the University of Hawaii is top-ranked with an average distance of over 1000 miles for each first-year student. Figure 15 shows that only 63% of first-year students attending the university are from the state and Hawaii has no adjoining states. Given its location, a similar result would be expected for the University of Alaska Anchorage, but the effect is not as pronounced because 87% of the university's first-year students are from the state.

Within the continental U.S., the University of Oregon (Figure 12 shows it attracting a high number of students from California), Montana State (Figure 13 shows it attracting a high percentage of students from Alaska and Wyoming) and the University of Colorado have the three highest migration distances for their first-year students. The results are a product of having relatively low percentages of in-state and adjoining state students (as shown in Figures 14 and 15) and being in located in geographically larger states so any out-of-state students are farther away.

At the other extreme, the University of the District of Columbia and the University at Buffalo have the two lowest migration distances because almost all first-year domestic students are in-state

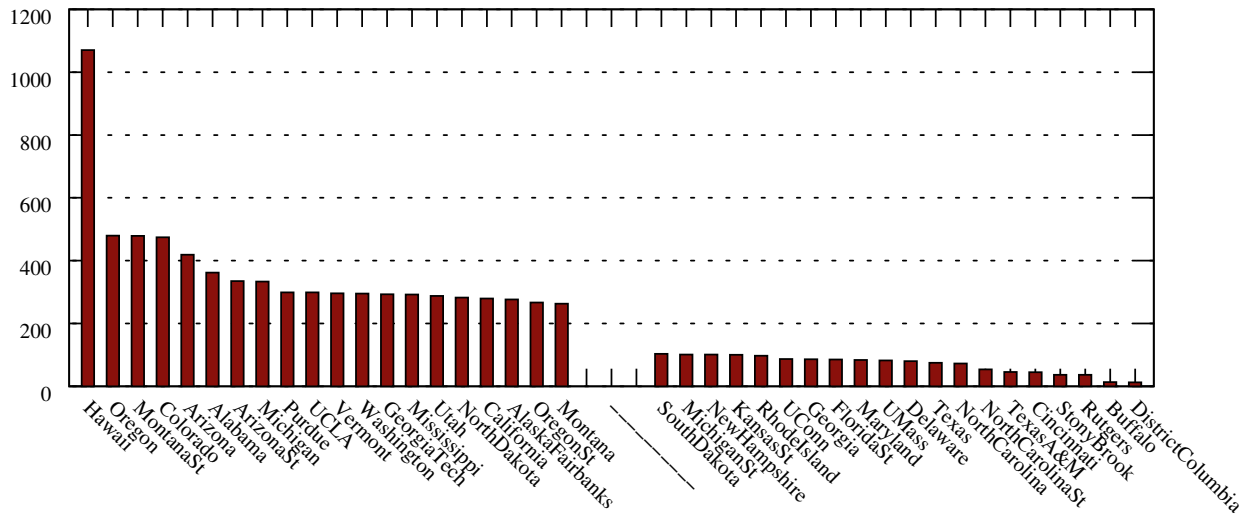


Figure 17: 20 Highest and Lowest Ranked Major State Institutions for Migration Distance (Miles) of U.S. First-Year Students

or from adjoining states. Rutgers University and Stony Brook University show the next two lowest average distances.

6.2 National Public Universities

Figure 18 shows the rank-ordered migration patterns for the 77 national public institutions based on the total enrollment of students from in-state, adjoining states and other U.S. states. Many institutions are repeated from the results shown in Figure 16, but the graph implicitly shows that the University of California-Irvine (19%), University of California-Davis (18%), and the University of California-San Diego (18%) enroll the most international students. The right-side of Figure 18 shows that many national public institutions enroll a small percentage of international students.

Figure 19 shows migration distance results for the group of national public institutions. It shows similar top-ranked institutions as shown in Figure 17 with the Colorado School of Mines added near the top of this group. The right side of the figure shows that CUNY City College, University of California-Merced, Rutgers University-Newark, University of California-Riverside and the University at Buffalo are the national public institutions with the lowest migration distance.

6.3 National Private Universities

Figure 20 shows the rank-ordered migration patterns for the 84 national private institutions based on the total enrollment of students from in-state, adjoining states and other U.S. states. The graph implicitly shows that the New School (29%), University of Rochester (28%), and New York University (25%) enroll the most international students. The right-side of Figure 20 shows that only a half-dozen national private institutions have less than one percent of international students enrolled.

Figure 21 shows migration distance results for the group of national private institutions with

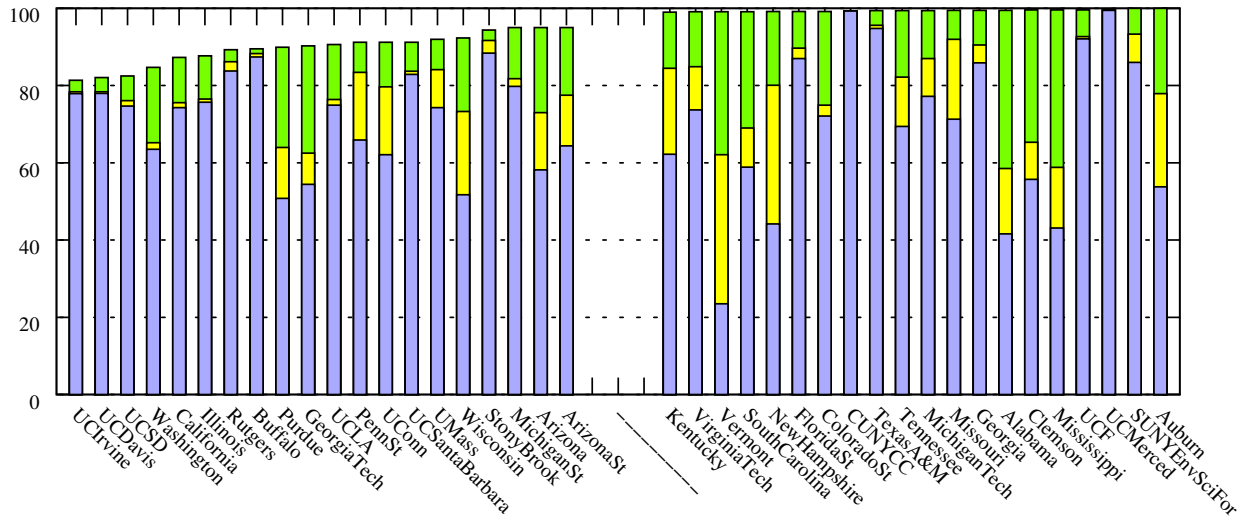


Figure 18: 20 Highest and Lowest Ranked National Public Institutions for Pct. of First-Year Students from In-State, Adjoining States and Other U.S. States

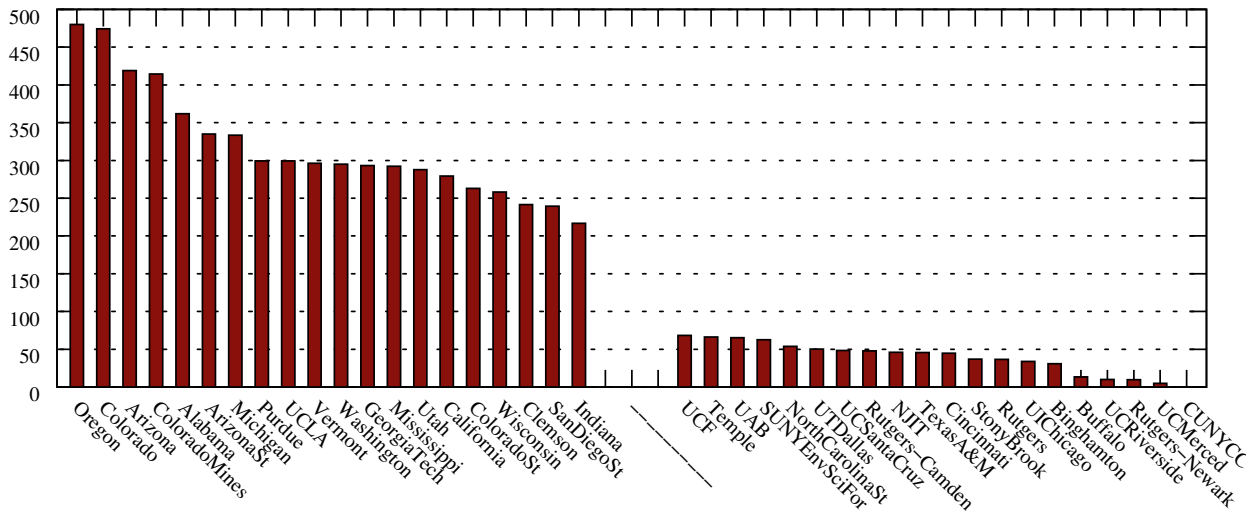


Figure 19: 20 Highest and Lowest Ranked U.S. News National Public Universities for Migration Distance (Miles) of U.S. First-Year Students

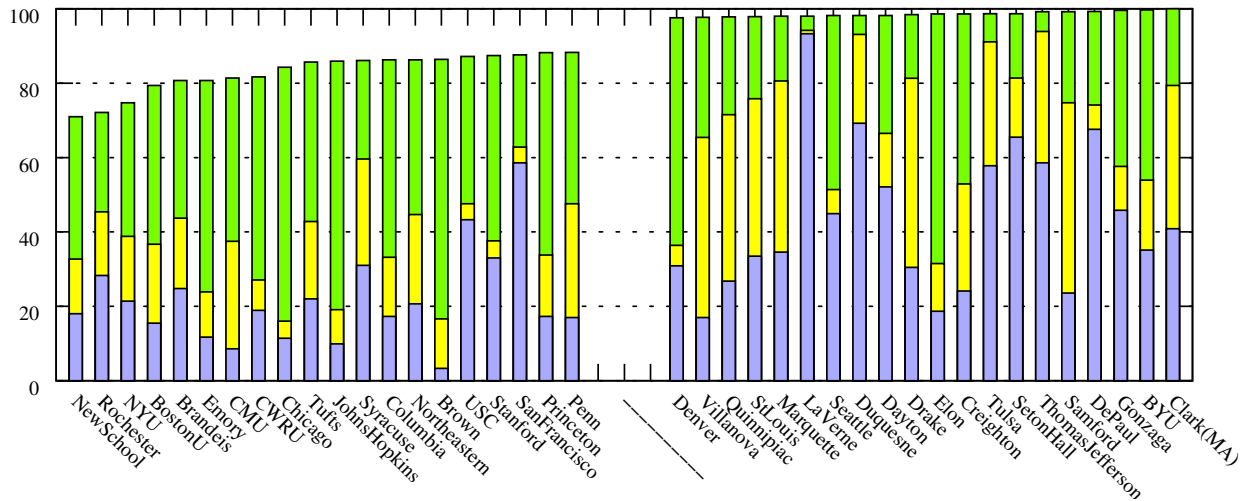


Figure 20: 20 Highest and Lowest Ranked National Private Institutions for Pct. of First-Year Students from In-State, Adjoining States and Other U.S. States

MIT and Stanford University having the greatest reach in the students they attract. California Institute of Technology and Dartmouth College have the next highest migration distance for their students. The right side of the figure shows that the University of La Verne, Thomas Jefferson University and the University of St Thomas are the national private institutions with the lowest migration distance.

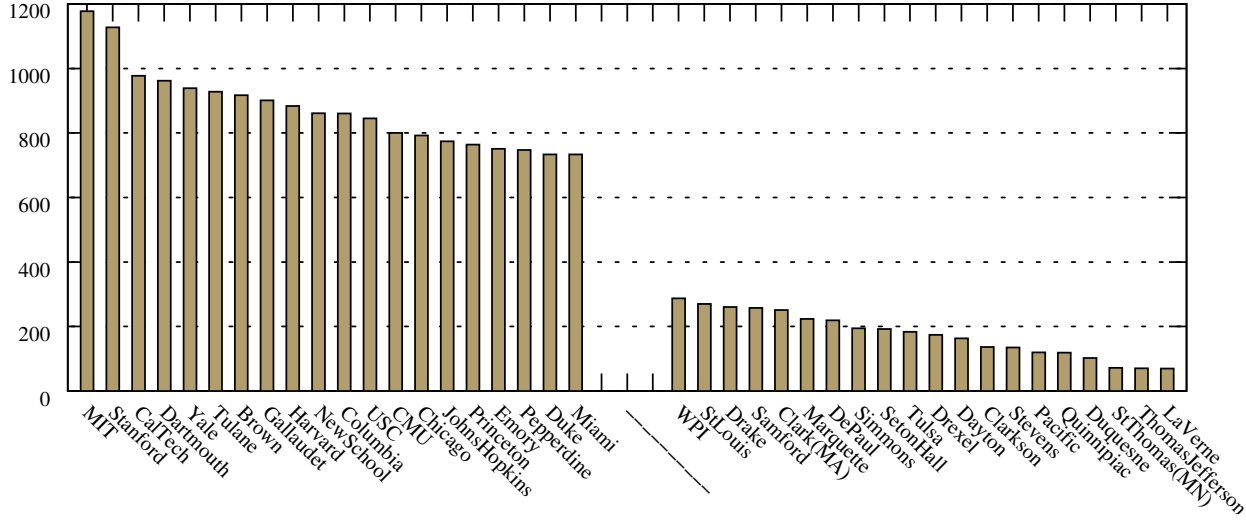


Figure 21: 20 Highest and Lowest Ranked U.S. News National Private Universities for Migration Distance (Miles) of U.S. First-Year Students

6.4 National Liberal Arts Colleges

Figure 22 shows the rank-ordered migration patterns for the 78 national liberal arts colleges based on the total enrollment of students from in-state, adjoining states and other U.S. states. The graph implicitly shows that the majority of Soka University (53%) students are international. It shows that Denison University (20%), Mount Holyoke College (19%) and DePauw University (19%) are next highest for international students. The right-side of Figure 22 shows that only a four national liberal arts colleges have less than one percent of international students enrolled.

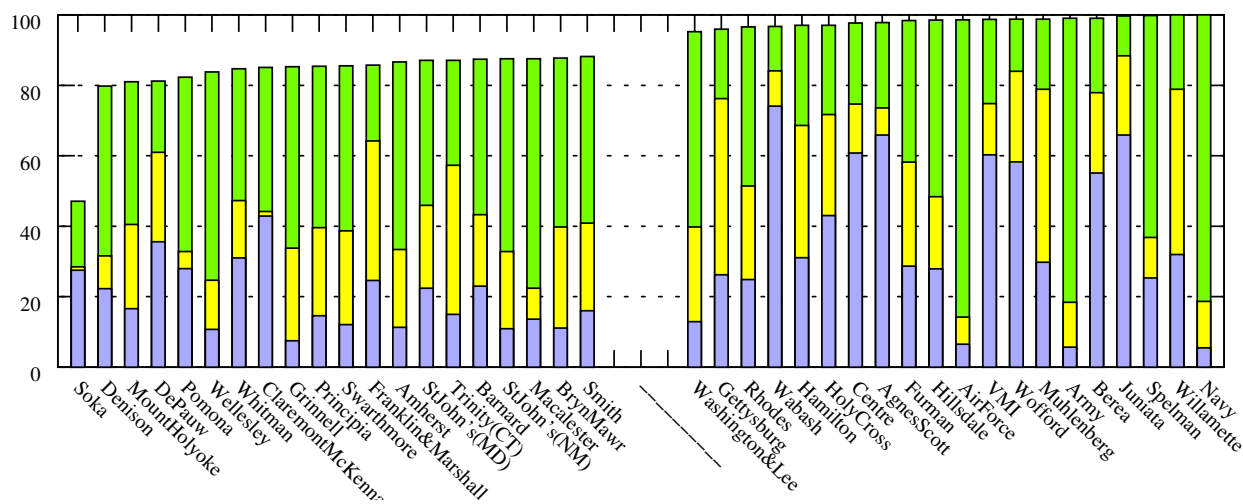


Figure 22: 20 Highest and Lowest Ranked National Liberal Arts Colleges for Pct. of First-Year Students from In-State, Adjoining States and Other U.S. States

Figure 23 shows migration distance results for the group of national colleges with Reed College and Thomas Aquinas College having the greatest reach in the students they attract. Pomona College and Wellesley College have the next highest migration distance for their students. Two public institutions, Army and the Air Force Academy, are next. The right side of the figure shows that Wofford College, Wabash College and Berea College have lowest migration distance for this group of institutions.

6.5 Historically Black Colleges and Universities

The migration patterns for Historically Black Colleges and Universities include relatively few international students with the majority of the 51 institutions enrolling less than one percent international students. Shaw University has the highest first-year enrollment of international students at 5%. There is more variation in the migration distance for this group as shown in Figure 24.

The figure shows that the private institutions of Howard University and Clark Atlanta University have the highest migration distance for this institution group. Spelman College and Oakwood University rank the next highest. The right side of the figure shows that the public institutions of the University of District of Columbia, Fayetteville State and Bowie State have the lowest migration distance for their first-year students.

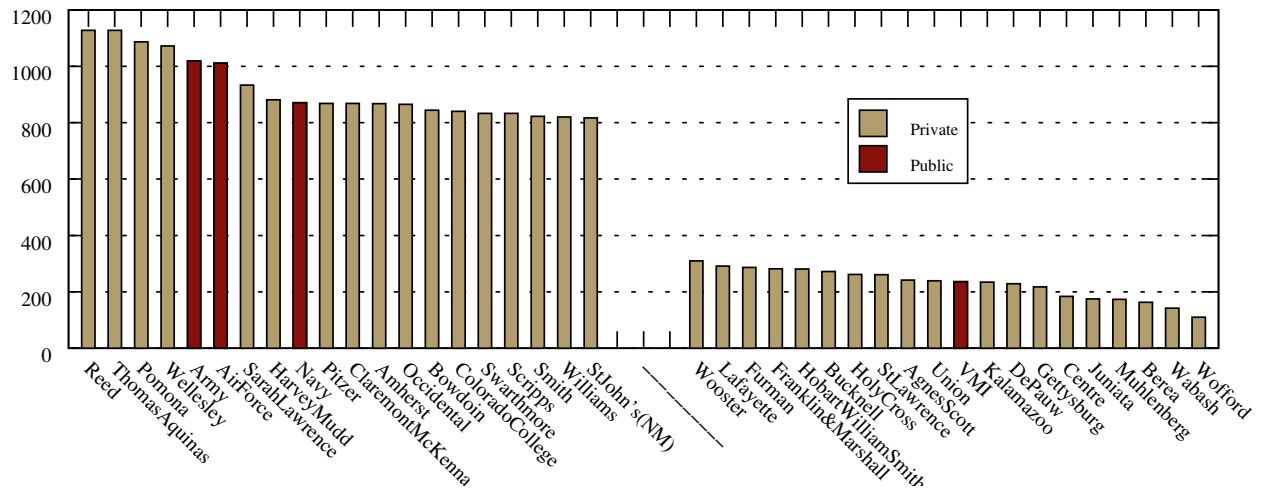


Figure 23: 20 Highest and Lowest Ranked U.S. News National Liberal Arts Colleges for Migration Distance (Miles) of U.S. First-Year Students

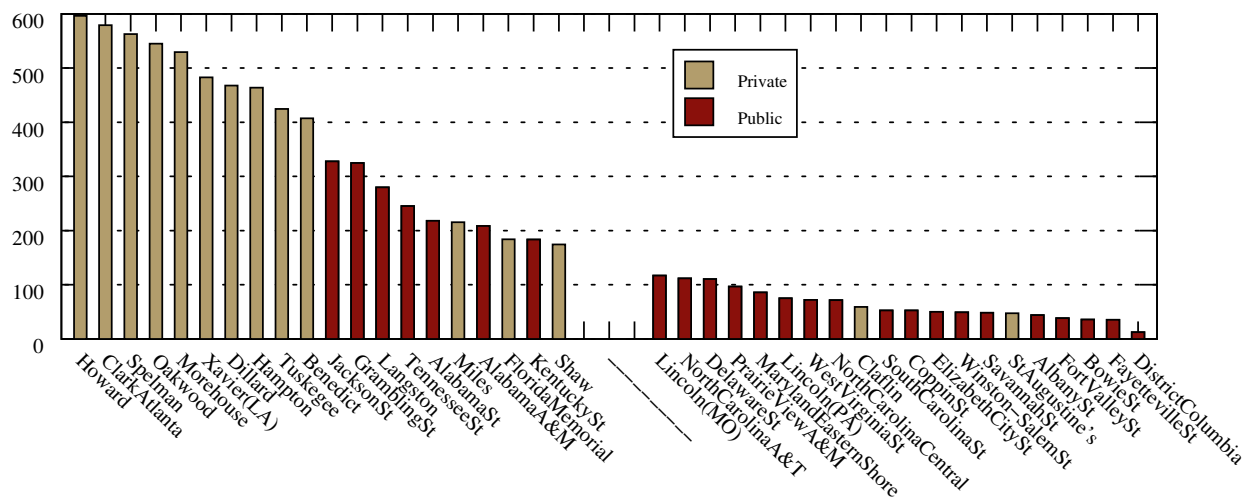


Figure 24: 20 Highest and Lowest Ranked Historically Black Colleges and Universities for Migration Distance (Miles) of U.S. First-Year Students

6.6 Primarily Online Institutions

The migration patterns for the 27 primarily online institutions also show relatively few international students with the majority of these institutions enrolling less than one percent international students. St. Leo University has the highest first-year enrollment of international students at 9%.

In analyzing the reach of these institutions, we not only consider the migration distance, but the number of first-year college students. Figure 25 shows a scatter plot of the results for this analysis where only institutions with at least 500 first-year students are shown to focus on the most significant institutions in this group. The results include public, private and for-profit institutions.

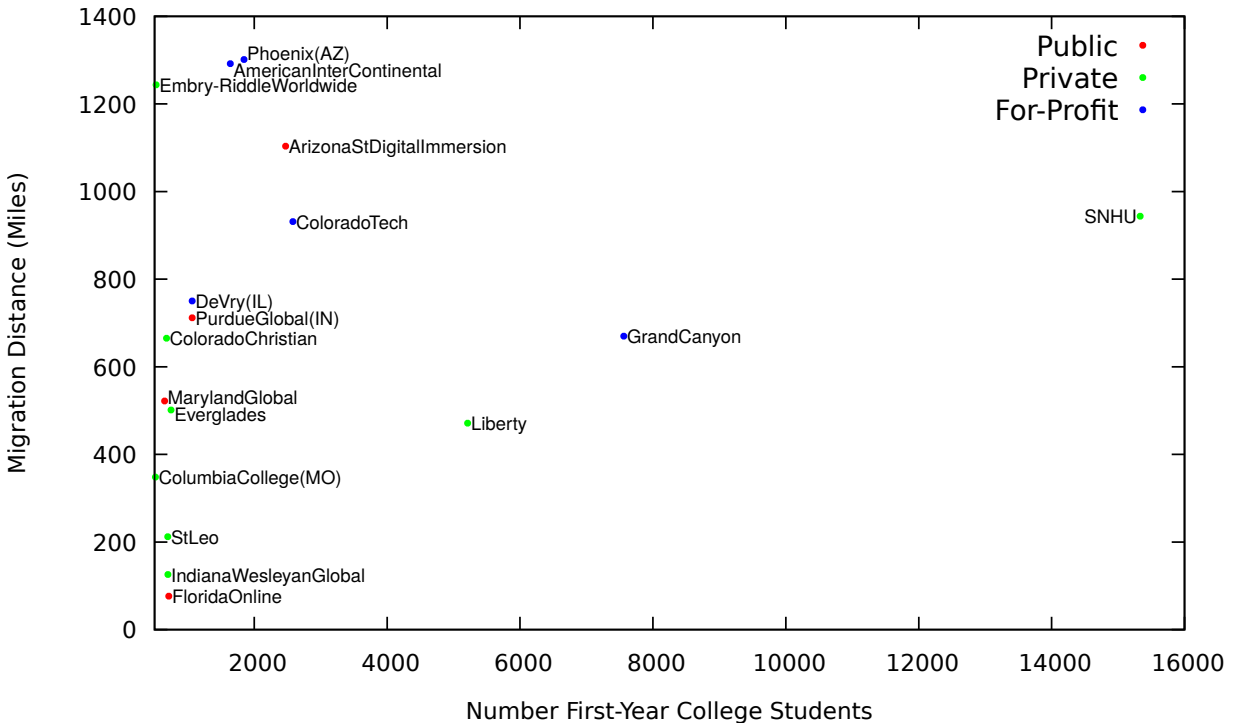


Figure 25: Number and Migration Distance of U.S. First-Year Students for Largest Institutions with Majority of Students Enrolled Exclusively in Online Education

The results show that Southern New Hampshire University enrolls the highest number of first-year students in this group. It has about double the next highest number by Grand Canyon University followed by Liberty University. Note in each case these are the total number of first-year students with the majority being online only. The results show that the University of Phoenix-Arizona, American InterContinental University and Embry-Riddle Aeronautical University-Worldwide have the most reach relative to the location of these institutions.

7 Impact of the Covid-19 Pandemic on Migration of College Students

The final phase of our work seeks to examine the initial impact of the Covid-19 pandemic on the migration of college students. The Fall'20 enrollment timeframe for the primary data we use is roughly six months after the beginning of the pandemic effects in the U.S. in March'20. The beginning of the pandemic coincided with college-bound students making their decisions for the upcoming academic year.

For this analysis we use IPEDS data from three even-year timeframes when student location data is more widely reported by institutions: 1) 2012, which provides data from earlier in the decade; 2) 2018, which has the last pre-Covid data; and 3) 2020, which has the first post-Covid data. We examine trends in four institutional metrics over these three timeframes: 1) percentage of fully-online students; 2) percentage of international students; 3) average number of first-year students; and 4) average migration distance of first-year students.

While we do analyze these trends for all institutions, we choose to characterize each result by reporting averages for all 4-year institutions in our study as well as the six institutional groups already introduced. This approach allows us to focus on the bigger picture for our results.

One consequence of the pandemic was that colleges and universities switched to online delivery of courses in Spring'20 and many continued this mode of delivery in the Fall'20. As a measure of this effect, we examined the percentage of all enrolled students (not just first-year) reported by institutions to be enrolled exclusively in distance education courses. We consider these students to be fully online. Results for this percentage across seven institutional groups over the three time periods are shown in Figure 26.

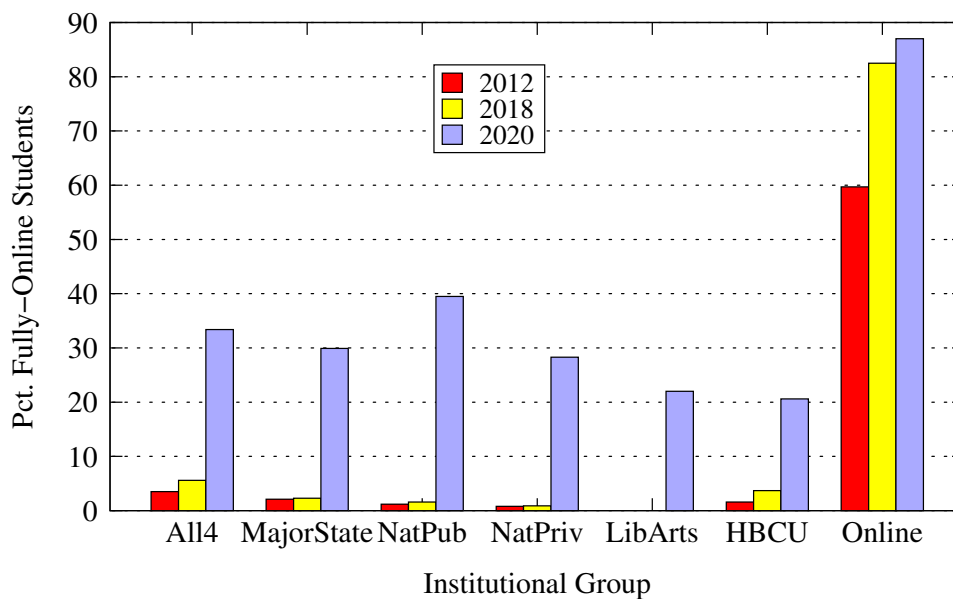


Figure 26: Percentage of Fully-Online Enrolled Students

The left-most cluster in the graph shows results for all 4-year institutions in our study. The

results show that 4% of all enrolled students in 2012 and 6% in 2018 were fully online. This percentage jumped to 33% in 2020. The figure shows similar significant jumps in 2020 for the specific institutional groups. The results for the primarily online group show 60% of the students were online in 2012, 83% in 2018 and up to 87% in 2020.

Another potential impact of the pandemic is on the number of international students that would be able to travel to the U.S. to attend college. Figure 27 shows the percentage of international first-year students for each of our institutional groups. The results show that the percentage of international students across all 4-year institutions was 3.7% in 2012 and 4.0% in 2018, but fell to 3.2% in 2020. As shown, all institutional groups showed a drop in international student enrollment between 2018 and 2020.

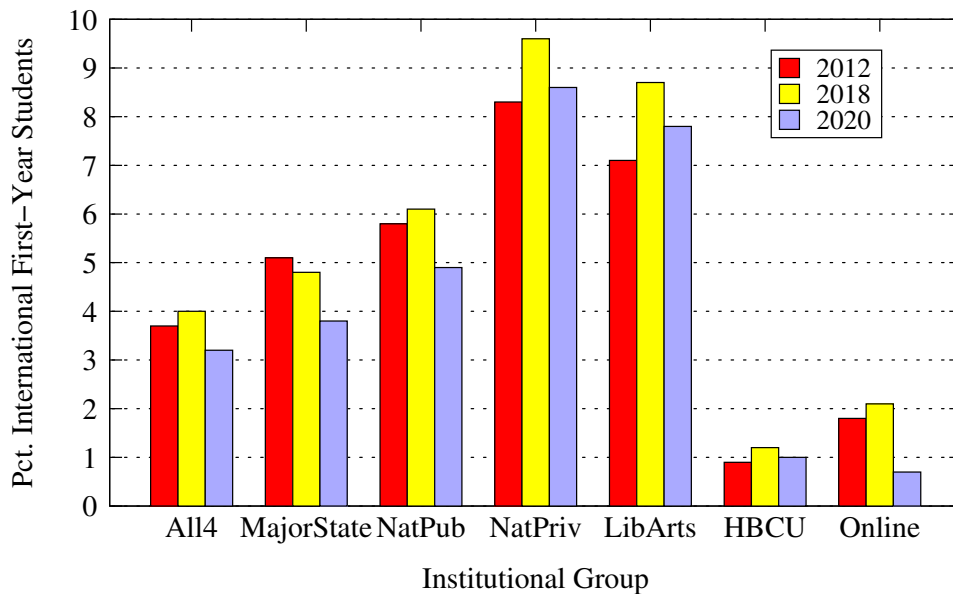


Figure 27: Percentage of International Students

We next examined the number of first-year students enrolled at each institution across the three years. We report the results as averages for each of the institutional groups in Figure 28. The results show that the average number of first-year students across 4-year institutions rose by 7% from 2012 to 2018, but dropped by 3% from 2018 to 2020. The results for specific institutional groups was mixed with average first-year enrollments for major state (1.2%), national public (1.7%), HBCU (6.3%) and primarily online (35.5%) institutions rising from 2018 to 2020, while enrollments for national private (5.0%) and national liberal arts colleges (9.7%) fell over this period.

Results for the average migration distance of U.S. first-year students to institutions within each group are shown in Figure 29. These results show that the average migration distance of first-year students for all 4-year institutions rose by 12.3% from 2012 to 2018 and again by 2.6% from 2018 to 2020. The average reach of institutions within each group rose between 2012 and 2018. Between 2018 and 2020, the average migration distance rose for national private (0.7%), HBCU 9.1% and primarily online (11.5%) institutions while it fell for major state (2.0%), national public (2.6%) and national liberal arts colleges (2.2%).

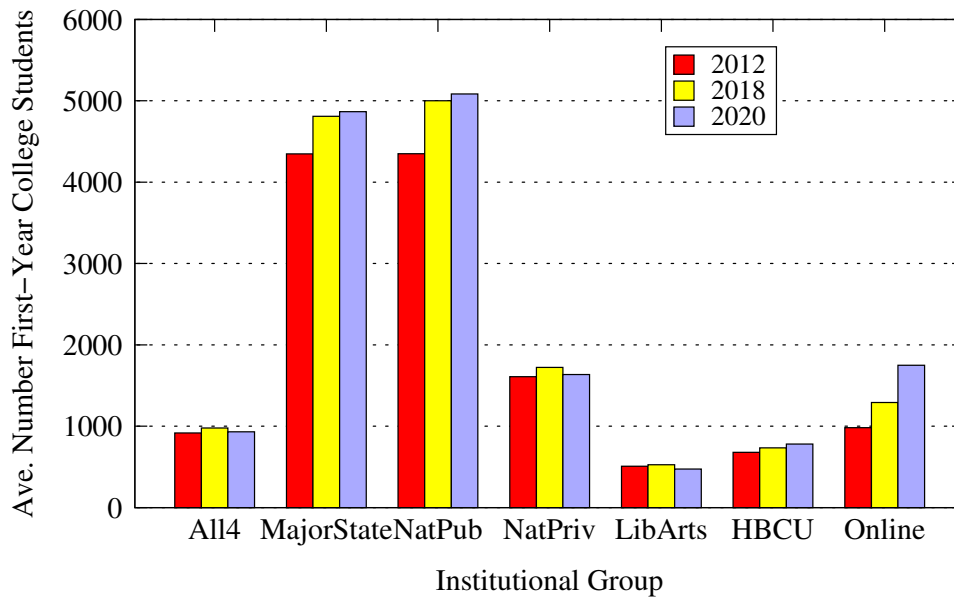


Figure 28: Average Number of First-Year College Students

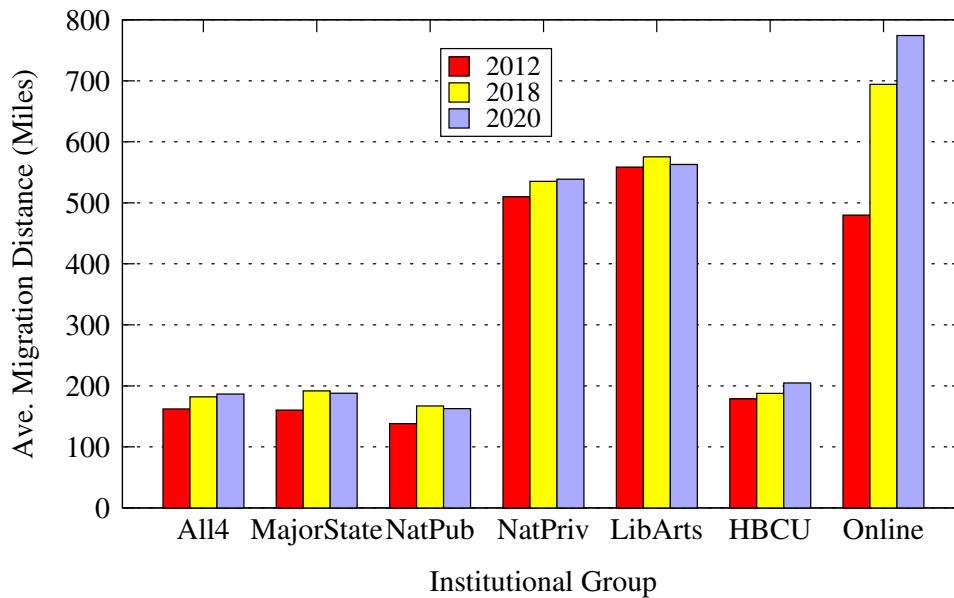


Figure 29: Average Migration Distance of U.S. First-Year College Students

Overall, the significant increase in the number of fully-online students and the drop in first-year international students due the pandemic are not surprising. Results for the other two metrics show variation among institutions in the various groups. On average, institutions in the HBCU and primarily online groups showed an increase both in the average number of first-year students and the migration distance for these students between 2018 and 2020. In contrast, national liberal arts colleges saw a decline both in the number and migration distance for first-year students. The major state and national public institutions tended to attract more students because of the pandemic, but the students tended to reside closer to the institution.

8 Summary and Future Work

This work studies the migration of college-bound students to attend American colleges and universities in the Fall 2020 timeframe. It makes use of the rich IPEDS data source augmented with additional data to determine both the migration patterns and migration distance for each 4-year institution in the U.S. These results are also used to characterize the movement of college students on a per-state basis.

The per-state analysis yields a number of interesting results. It shows that Pennsylvania, New Hampshire and Indiana have the largest net inflow of college-bound students. In contrast, New Jersey, Illinois and Texas have the largest net outflow of such students.

Using the percentages of college-bound students enrolling in-state as well as first-year students enrolled in colleges of the state, we are able to characterize the college “market” of each state. It shows that Texas, Louisiana and Michigan are the most self-contained markets with both a higher than average percentage of college-bound students remaining in state and a higher than average percentage of first-year college students from in-state. The District of Columbia, Vermont and New Hampshire are free markets with relatively more student movement in and out of the state. The results suggest that more in-state college capacity is needed for college-bound students in New Jersey and Alaska. Colleges in these markets may also be less attractive as these states both enroll relatively fewer in-state college-bound students as well as out-of-state first-year college students. In contrast, the results suggest that North Dakota, West Virginia and Utah may have more college capacity than is needed. Colleges in these markets may also be more attractive as these states both enroll relatively more in-state college-bound students as well as out-of-state first-year college students.

In terms of retention of in-state college-bound students, the District of Columbia ranks the lowest with New Hampshire, Illinois and Vermont as next lowest. Public institutions in Utah, Louisiana and West Virginia retain the highest percentage of their own college-bound students. In parallel, New York, Massachusetts and Pennsylvania have the most of their college-bound students attending in-state private institutions while few such students attend private institutions in Wyoming, Nevada, Alaska and New Mexico.

The per-state migration patterns show that institutions in Nevada have the most students from in-state or an adjoining state with Texas and Arkansas the next most. Institutions in Massachusetts, the District of Columbia, California, New York and Hawaii have the highest percentage of international students attending them.

In terms of migration distance, first-year students for institutions in Hawaii, New Hampshire and the District of Columbia have the largest distance between home and school while institutions

in New Jersey and Texas have the smallest. College-bound students from Hawaii, Alaska, Oregon and California attend college furthest from home while students from West Virginia, Indiana and Kentucky attend college closest to home.

Looking at the student migration paths of specific institutions, Texas A&M and Penn State enroll the most first-year students from their own state. Nearly 50% of college-bound students from Wyoming enroll at the University of Wyoming. Southern New Hampshire University, as a large primarily online institution, enrolls a relatively high number and percentage of college-bound students from multiple states.

The migration patterns for major state institutions show Texas A&M and the University of Texas have the highest percentage of first year students from their state while the University of Vermont has the lowest. The University of the District of Columbia and the University of Nevada enroll the highest percentage of in-state or adjoining state students while the University of Michigan, University of Colorado and University of Alabama enroll the smallest percentage in their immediate region. First-year students at the University of Hawaii, University of Oregon, Montana State and the University of Colorado have the highest migration distance to attend these institutions.

Similar migration patterns and migration distance were computed for national public universities, national private universities, national liberal arts colleges, historically black colleges and universities, and primarily online institutions. Focusing on migration distance shows that MIT and Stanford, followed by Cal Tech and Dartmouth, have the greatest reach for national privates. Reed College and Thomas Aquinas College, followed by Pomona College and Wellesley College, have the largest migration distance for the liberal arts colleges with Howard University and Clark Atlanta University having the greatest reach for HBCUs.

The results for primarily online institutions show that Southern New Hampshire University enrolls the highest number of first-year students in this group followed by Grand Canyon University and Liberty University. The results show that the University of Phoenix-Arizona, American InterContinental University and Embry-Riddle Aeronautical University-Worldwide have the greatest reach relative to the location of these institutions.

Finally we examine the initial effects of the Covid-19 pandemic by comparing the Fall 2020 data with previous years. Not surprisingly, these initial pandemic results show a significant increase in the number of fully-online students and a drop in first-year international students. There is more variation among institutional groups. On average, institutions in the HBCU and primarily online groups showed an increase both in the average number of first-year students and the migration distance for these students between 2018 and 2020. In contrast, national liberal arts colleges saw a decline both in the number and migration distance of first-year students. The major state and national public institutions tended to attract more students because of the pandemic, but the students tended to reside closer to the institution.

This work also points to a number of directions for future work. These directions include:

1. making comparisons in other institutional 4-year peer groups,
2. performing similar analysis for 2-year institutions,
3. expanding on the study of fully-online students where migration distance likely does not involve travel from home to school for a student, and

4. continuing to study the impact of the pandemic on student migration patterns.

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