Competition Among Colleges for Students Across the Nation

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Abstract

Colleges compete with one another for students. This paper overcomes historical data limitations associated with forming a national picture of competition among colleges by using the universe of SAT-takers. We identify and measure competition by the overlap within the set of colleges to which students send their SAT scores (Score Sends). We document the competitive landscape for 1,152 colleges between 1996 and 2013 including the number of competitors, the intensity of the competition, and characteristics of a college's primary competitors. For example, on average, a college has Score Send overlap with 736 other institutions and their primary competitors are located 104 miles away and have 34.2 percent Score Send overlap. All of the documented measures of competition vary greatly by institution type but do not change dramatically over the time period examined.

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1. Introduction

It is well understood that competition can affect the price and quality of goods and services in a market,[1] which is a key argument in the education literature on charter schools and school choice (e.g., Hoxby, 2000; Rothstein, 2007; Lubienski, 2003; Lubienski & Lubienski, 2006; Buckley & Schneider, 2007). The effect of competition on education is also present in higher education (Hoxby, 1997) but the market is complicated by the fact that colleges compete with one another on multiple dimensions, including for students, faculty, and funding (Brewer, Gates, & Goldman, 2002). With regard to competition for students in higher education, prior research has documented aggregate measures of competition and changes over time, particularly students' increasing willingness to travel to more distant colleges (Hoxby, 1997; Terry-Long, 2004; Bound, Hershbein, & Terry-Long, 2009; Hoxby, 2009). For elite colleges, the competition is for the best and brightest students, which may manifest into merit aid (Griffith, 2011; Hurwitz, 2012), gaming the rankings and cheating scandals (Conlin, Dickert-Conlin, & Chapman, 2013; Anderson and Johnson, 2012; Marcus, 2013), and a non-educational expenditures arms race (Jacob, McCall, & Stange, 2013). More commonly, the competition is about attracting students who are eager to learn and have potential to succeed (Jaschik, 2012), but also to help the bottom line (Jaquette, 2013; Jaschik, 2009).

Despite the consensus that colleges *are* competing with one another for students, there is little research on *which* colleges are competing with one another for *which* students. This is primarily a result of data limitations that typically take one of two forms. First, nationally representative datasets have few, if any, students enrolled at each college. Second, individual colleges, state systems, or consortia[2] collect and share data on their own applicants and enrollees, which may include some information on its competitors. Such data do not represent the national landscape and are often based on imperfect student feedback. Consequently, information on competitors may come from incomplete data, rankings, or even perception. This paper overcomes these data deficiencies with the universe of SAT-takers between 1996 and 2013. For each of the millions of students in the data, we observe the colleges that receive an official SAT score report (Score Send), which is a measure of a student's choice set. The overlapping colleges in these

[1] There are countless economic studies on this subject and the idea appears in most microeconomic textbooks.
[2] Data sharing include Consortium on Financing Higher Education (COFHE) and potentially the Common Application. Avery et al. (2013) survey students at elite colleges in the College Admission Project.

students' choice sets allow us to determine a unique measure of colleges' competitors.[3]

We use a balanced panel of 1,152 colleges nationwide to analyze the competitive landscape for different types of institutions, as measured by size, sector, selectivity, and other important institutional factors.[4] The competitive landscape is described by several novel variables, including the number of competitors and the "intensity" of competitors, where intensity is defined as the percent of Score Send overlap between an institution and each of its competitors. Given that the more intense competitors are more likely to influence a college's decisions, we also examine the details (e.g., distance and characteristics) of the five most intense competitors.

We start our analysis by documenting the number of competitors that colleges have and how this outcome varies by college type. While each competitor may exert some competitive pressure on a college, the number of competitors is also a way to describe the market concentration for a subset of students, which is often related to quality and pricing (Viscusi, Harrington, & Vernon, 2005), even in higher education (Hoxby, 1997). We find that, on average, colleges have 736 competitors but this is accompanied by a large variance around the mean, even after accounting for college size. In other words, some colleges face a large number of competitors compared to others, which may impact colleges' decisions and offerings, as evidenced by observed patterns in other industries (e.g., Hoxby, 2000; Mazzeo, 2003; Gaynor & Town, 2011). More specifically, our regression analyses indicate that, conditional on enrollment size and a host of other college characteristics, private nonprofit institutions and the most selective colleges tend to have more competitors than public and less selective colleges. This result stems, in part, from students who apply to selective and private colleges also tending to apply to more colleges (Hoxby & Avery, 2013), and also from applicants being geographically dispersed, which comes along with a range of regional preferences. In addition, historically black colleges and universities (HBCUs) and colleges with graduate programs, a business school, and NCAA membership all have relatively more competitors.

[3] An alternative measure of competition can be constructed with matriculation decisions among the set of colleges that students are granted admission (e.g., Avery et al., 2013). This is a useful metric that need not be highly correlated with our measure and it does not capture the entire competitive landscape. First, colleges do compete for applications since they impact admit rates and rankings, regardless of enrollment. Second, if College X consistently matriculates students over College Y, they may not be deemed strong competitors. However, they are certainly closer competitors to one another than either are with College Z, which has no Score Send or application overlap with College X or College Y.

[4] Other institutional characteristics include whether an institution is a flagship, HBCU, or two/four-year, has graduate programs, law school, business school, engineering program, or hospital, is a member of the NCAA, and urbanicity.

In addition to the number of competitors, the intensity of the competition for a college is an important part of the competitive landscape. As an extreme example, a college with exactly one competitor (where all its applicants also submit SAT scores) may be operating in a more competitive market than a college with 1,000 competitors where only a few students apply to each of the competing institutions.[5] We find that, among the relatively many competitors that private and selective colleges have, those competitors are more likely to be low intensity competitors (score sending overlap less than 20 percent). In contrast, public institutions are much more likely to have at least one high intensity competitor, including an average of 0.14 more competitors with at least 50 percent score sending overlap than private institutions. Combined, it is clear that colleges face various types of competition, ranging from many competitors to more intense competitors (or both), and the competition systematically varies by college characteristics.

Next, our analysis examines the details of each college's five most intense competitors, that is, the five competitors with the most Score Sends in common. On average, the first competitor has an intensity of 34.2 percent while the fifth competitor's is 15.1 percent, but this varies by college type. Unconditionally, the average distance between a college and its most intense competitor is 104 miles and each subsequent top five competitors is relatively more distant. This implies that geography is a major determinant of a college's competitor. In the regression framework, the average distance between the most selective institutions and their top competitors is about 120 miles greater than the distance between the least selective institutions and their top competitors. Having more distant competitors is also more common among colleges with an engineering program or a hospital, or among institutions that offer Master's or Ph.D., as well as flagships, and HBCUs. Public and two-year institutions, on the other hand, have competitors that are located in closer proximity relative to private or the least selective four-year institutions, respectively. This not only implies the well understood phenomenon that college is rather local for many students (Hoxby, 2009), but also that competition is local for colleges that serve these students.

Additionally, we find that colleges are much more likely to compete with other colleges that have similar characteristics, such as those located in the same state, the same sector, or of the same selectivity level. This may reflect student preferences for a certain type of college that

[5] Regardless of intensity, even a single competitor can greatly influence decisions, such as price setting. For example, the Bertrand pricing model that reaches competitive market prices or price wars (e.g., Bresnahan, 1987).

generates fairly homogeneous application sets. Relatedly, we show that the institutional competitors for one subgroup of students are not necessarily the same for another subgroup. For example, a college's most intense competitor for white students is only the same most intense competitor for black students 39 percent of the time. This implies that colleges that wish to craft a diverse class, which they often claim to do (Maltz Bovy, 2013), must be mindful of the variation in competing colleges for various subgroups.

Together, we see that there are many nuances in how colleges compete with one another, as evidenced by the variety of most intense competitors. These nuances do not change much over the 18 year sample period, perhaps suggesting that the increased selectivity of the most elite colleges in the prior decades has tapered off (Hoxby, 2009).

Finally, we use network analysis to examine the reciprocity between colleges in the probability of being declared a competitor. For example, all students who send scores to College A may also send scores to College B but most students who send a score to College B do not send a score to College A, implying that the relationship is not reciprocal. By construction, a college has five most intense competitors. However, in our data, a college can be named among the top five competitors by other colleges anywhere between zero and 118 times. In fact, we find that unconditionally, the most selective institutions tend to be the main competitor on average, 2 times more frequently than the least selective institutions (i.e. least selective institutions are the main competitor for an average of 0.3 colleges and the most selective institutions are the main competitors of 2.3 colleges). They also tend to be among the top five competitors 8.8 times more frequently (i.e. 2 versus 10.8). Conditional on a host of college characteristics, these estimates are 1.1 and 6.6 times more frequently, for the main competitor and among the top five competitors, respectively. In addition, institutions that offer Master's or Ph.D., HBCUs, and those with larger enrollments are the competitors to more colleges. Conversely, two-year institutions are considered competitors less frequently relative to the least selective four-year institutions, as are NCAA colleges relative to non-NCAA colleges. These differences by institution type suggest an asymmetry in how colleges perceive one another and that competitive pressure may not be a two way street.

This research makes several contributions to the literature. First, the paper uses new data and consequently, is the first to use this measure of competition in the market for higher education. On the one hand, this measure does not capture all measures of competition, such as where students

matriculate from among their set of acceptances. On the other hand, moving back a step to the Score Send or application stage provides a different measure of competition and, combined with these vast data, represents one of the most complete pictures of the postsecondary competitive landscape. Second, most of the literature considers how students make decisions about where to apply and enroll, whereas this paper asks a somewhat different, but related, question about which colleges compete with each other for student interest. Our data allow us to examine the full distribution of college competitors and to capture the intensity of the competition for different types of institutions. Finally, the network analysis provides a new perspective on the asymmetry of the higher education market.

In addition to the contributions to the literature, this paper sheds light on a college's competitors, which has important implications for colleges and policy. Competition in higher education can have direct implications for how colleges determine tuition levels and financial aid generosity in addition to educational and non-educational expenditures and investments. Furthermore, analysis of higher education's competitive landscape can better inform colleges on practices and procedures to attract and retain the students they want. Such information is becoming increasingly important in a time when colleges are operating on tight budgets and many institutions seek to better fulfill their missions. Attracting the correct mix of students can improve outcomes such as persistence and graduation rates, which are goals shared by all institutions and policy makers.

2. Data

The primary source of data is College Board SAT-takers in the graduating high school cohorts between 1996 and 2013. Each year, well over a million students take the college entrance exam. We observe the students' SAT score on their final attempt, if they take the test multiple times. In addition, upon SAT registration, students fill out a questionnaire that provides us with basic demographics such as parental income and education, and race/ethnicity.[6,7] The data also

[6] We have over 90 percent response rate on race/ethnicity, about 80 percent for parental education, and about 45 percent for parental income. We do not know the distribution of demographics for non-responders and we do not have reason to believe that their score sending patterns are much different than responders with the same demographics.

[7] We exclude foreign students and American students who live in Alaska, Hawaii, and other U.S. territories. Including Americans from these distant regions has little impact on results because there are relatively few of them.

include information on where students send their SAT scores (Score Sends), which is nearly always required when applying to college.

2.1. Score Sends

Our data include up to 30 SAT Scores Sends for each SAT-taker that are observed at the time of high school graduation. A Score Send can be sent without applying to a college and an application can be submitted without sending scores, particularly if the student takes the ACT or the college does not require any college entrance examination. However, Score Sends have been shown to be good proxies for applications (Card & Krueger, 2005; Pallais, 2015), though not perfect predictors of application (Smith, Forthcoming). More importantly, Score Sends are a measure of student interest in colleges, thus representing a student choice set.

Upon SAT registration, students are given four free Score Sends to colleges, which are only free up to a few days after the day of the test administration.[8] Each additional Score Send to a college costs about $10. On average over the sample period, students sent just over five Score Sends and the median number of Score Sends that a college receives is 1,564.[9]

2.2. Defining a College's Competitors

To define competitors, we take the subset of students who send SAT scores to a particular college. Using that subset of students, we identify the set of institutions to which these students also send their SAT scores. The identified institutions are a college's "competitors." We count the number of competitors for each institution in each year, even if only a single student sent scores to both colleges. We also create a measure of a competitor's "intensity," which we define as the percent of Score Send overlap between an institution and its competitor. For example, if College A receives 5,000 Score Sends and 2,000 of those students also send scores to College B, the intensity is 40 percent. We calculate the intensity of each competitor.

[8] In 2007, low-income students who registered with a fee waiver were eligible for eight free score sends, which impacted students' college enrollment and completion (Hurwitz, et al., 2017).
[9] This statistic is for colleges in our sample, which is described below.

A portion of this paper focuses on a college's five competitors with the five largest intensities. These top five competitors are calculated for each college in each year because competitors can change over time. We repeat the same process for each of the subsets of students grouped by parental income and education, race, and SAT scores.[10] For example, we find all Hispanic score senders to a college in a year and then find the five colleges that have the most overlap for that subsample of Hispanic students. Note that the top competitors to a college need not be the top competitors to a college for different subgroups. For example, a large public university may be the top competitor to a proximate small institution; however, all the black students who apply to the small institution may also apply to a nearby HBCU, but not the large public university. These measures are meant to capture the fact that certain types of institutions may have different competitors for different types of students.

It is important to note that we are only using data on SAT-takers and not analogous data on ACT-takers to define competitors. There is the potential that incorporating data on students who only take the ACT may yield different results, particularly at colleges that attract ACT-takers. To that end, we perform two robustness checks for the main analyses. First, we restrict our attention to "SAT dominant states," where the majority of college entrance exams is the SAT.[11] Second, we restrict our attention to the colleges where at least 50 percent of students submit an SAT score (leaving about 65 percent of the colleges in the sample).[12] As we will show in the appendix, all primary results are qualitatively unchanged by such sample restrictions.

2.3. College Characteristics from IPEDS and Barron's

For each college (and its competitors) we merge in its characteristics from the Integrated Postsecondary Education Data System (IPEDS). Dummy variables include whether each institution is public or private, two-year or four-year, whether it offers advanced degrees, has a hospital, if it is a HBCU, a member of the NCAA, or it is a flagship institution. We also know the

[10] Income groups are defined as follows: low-income (<$40,000), middle income (between $40,000 and $100,000), and high-income (>$100,000). Furthermore, parental education groups include students with both parents having a high school diploma, some college or less, or one parent has at least a Bachelor's degree. SAT bands are: less than a 1000, 1000-1090, 1100-1190, 1200-1290, and greater than or equal to 1300.

[11] These include CA, CT, DE, DC, FL, GA, IN, MA, MD, ME, NC, NH, NJ, NY, OR, PA, RI, SC, TX, VT, VA, and WA.

[12] The data to identify colleges where at least 50 percent of students submit an SAT score come from IPEDS.

urbanicity of the college (rural, town, suburban, or city), its enrollment in each year, and whether there is an affiliated law school, business school, or engineering program.[13] We also obtain a college's latitude and longitude from IPEDS, which allow us to calculate the distance between the college and each of its top five competitors.

To these data, we merge information on the college's Barron's Admissions Competitive Index. The Barron's index categorizes colleges into the following categories:

- Most Competitive
- Highly Competitive
- Very Competitive
- Competitive
- Less Competitive
- Noncompetitive
- Special

The ordinal categorization is a function of SAT/ACT scores of accepted students, the admission rate, and the GPA and class rank required for admission. Barron's does not include two-year colleges. Due to the small number of colleges in "most competitive" and "highly competitive" categories, we create a binary variable equal to one if they are in either of those categories and equal to zero otherwise. We also create dummies for whether an institution is in Barron's category 3 ("very competitive"), Barron's category 4 ("competitive"), and the special category. The "less competitive" and "noncompetitive" are both omitted, such that regression estimates will be relative to these less competitive colleges.

2.4. Final Data Set and Descriptive Statistics

We start with all colleges in IPEDS, such that we have an observation for each college in each year. However, many colleges receive few or no Score Sends. This may be because the

[13] Engineering programs for undergraduates are listed in IPEDS. Whether a law school is affiliated with the college is in IPEDS in 1996 and for later years, we supplement that with the few colleges who have started a law school since 1996, according to the American Bar Association. The list of 359 business schools in the U.S. and the affiliated college is taken from Wikipedia.

college is open admissions and hence requires no admissions test (such as most two-years) or most students at the college take the ACT. Hence, we drop observations that have fewer than 200 Score Sends in a year. To obtain a balanced panel, we also drop colleges in which any year has fewer than 200 observations. We also exclude colleges outside the continental United States.

As displayed in Table 1, we are left with a balanced panel of 1,152 colleges over 18 years, generating 20,736 observations. We have slightly more private, non-profit institutions in our sample than public colleges. More than half of the institutions have graduate programs, about 30 percent have either business school or engineering program, and 15 percent have an affiliated law school. Flagships, HBCUs, or institutions with hospital are a small proportion of the sample. About two-thirds of institutions are either less selective institutions (Barron's categories 4 through 6) or community colleges, while 35 percent are categorized within the top 3 Barron's categories. About 80 percent of the institutions are located in city or suburban areas. Average freshman enrollment is 1,132.

Institutions have an average of 736 competitors but that ranges from just under 100 competitors to over 2,000. In the latter set of analyses we focus on the characteristics of the five most intense competitors. As shown in Table 1, average intensity of the top five competitors is 23 percent. In addition, on average, these competitors are located 147 miles away from their respective institutions.

3. Methods

The basic model we estimate is as follows:

$$Y_{st} = X_{st}\beta + Z_s\gamma + T_t + \mu_s + \varepsilon_{st} \qquad (1)$$

where Y_{st} is an outcome related to school *s* in year *t* (e.g., number of competitors). Hence, an observation is a college in a year. The vectors X_{st} and Z_s represent the observable characteristics of the college that are time-varying and time invariant, respectively. In most models, Z_s includes state fixed effects to account for geographic related issues, such as population density and isolation from other colleges and states. T_t is a vector of year dummy variables. The last two terms, μ_s and ε_{st}, are the unobservable school effect that is constant over time and the idiosyncratic error

term. In some models, we ignore the school-specific shock or econometrically, it is subsumed in the error term. However, there is reason to believe that the school-specific shock μ_s exists since some colleges tend to get more applications than others and this is persistent over time for reasons not explained by the other covariates. Therefore, we also test the robustness of our results where μ_s is a random effect that is uncorrelated with the other covariates, which also improves efficiency over the OLS estimator by removing the school shock from the composite error term. Finally, our primary results cluster at the school level to account for any potential serial correlation.[14]

The second set of analyses focuses on the top five intense competitors, so the unit of observation becomes a competitor to a college in a year. This is expressed by the following specification:

$$Y_{stc} = X_{st}\beta + Z_s\gamma + C_c + T_t + \mu_s + \varepsilon_{stc} \qquad (2)$$

where Y_{stc} is an outcome related to school *s* in year *t* and its competitor *c* (e.g., intensity or distance in miles). Other variables are the same as in equation (1) but here, C_c is a vector of dummy variables for each competitor number (i.e., second, third, fourth, and fifth).

3.1. Network Analysis

In addition to exploring the characteristics of competitors, we also perform a network analysis based on the five most intense competitors. We focus on the number of colleges that call the institution a competitor (the in-degree of a college). So unlike the previous analyses that describe the competitors from the perspective of a single institution, the network analysis characterizes the competitive landscape from the perspective of the competitors. These perspectives need not be symmetric. For example, many small colleges likely list large public universities as a competitor, while the reverse is less likely to be true.

For the analyses, we calculate three additional outcome variables: frequency with which each institution is determined to be the top competitor, among the top three competitors, and

[14] We also cluster standard errors at the state level but they are slightly larger than clustering at the school level. Despite not influencing statistical significance or conclusions drawn, we present the more conservative standard errors clustered at the school level.

among the top five competitors. As the bottom of Table 1 shows, on average, each institution is determined to be the main competitor once and either three or five times among top three competitors or top five competitors, respectively. However, this is heavily skewed as some colleges are determined to be strong competitors over 100 times.

4. Results on Full Set of Competitors

4.1. Number of Competitors

Figure 1 displays the distribution of the number of college competitors, averaged across 18 years for each college. As shown in the figure, most institutions have between 500 and 1,000 competitors. There exists a small set of institutions with more than 1,500 competitors indicating that some institutions face quite a few different competitors from across the nation. Some of this variation is driven by differences in college attributes but in Appendix Figure 1, we show that even after controlling for observable characteristics of colleges (i.e., institutional size), there is still a great deal of variation in the number of competitors.

Beyond the institutional size, we also test whether some types of institutions have more competitors than others. Table 2 displays the results of this line of inquiry, which are estimates from a regression of the number of competitors on institutional characteristics, as demonstrated in equation (1). The first column in Table 2 shows the results of the previously described OLS model and the second column includes state fixed effects. The third column, which is our preferred specification, also controls for college enrollment. Standard errors are clustered at the college level.

Scanning across the first three columns suggests that state geography does not play a critical role in the estimates, but enrollment is correlated with the other variables, and hence, is included in future regressions. Overall, the regression results displayed in Table 2 indicate that selective, private, and institutions with specialized programs have more competitors than their counterparts. Specifically, the most selective institutions have, on average, 328 more competitors than the least selective institutions. This is likely because the most selective institutions have applicants who apply to relatively many colleges that are relatively distant, thus creating more competitors.

We also find that colleges that offer Master's or Ph.D.s, and colleges that have business schools or engineering programs have, on average, about 70 more competitors relative to colleges without these programs. Additionally, colleges that are members of the NCAA, HBCUs, or institutions located in urban areas face more competitors than colleges without those attributes. Conversely, public and two-year colleges tend to have fewer competitors than their private and four-year college counterparts. It is worth noting that controlling for enrollment in column 3 flips the sign of public and flagships' coefficients. This is because public colleges tend to be larger than private colleges.[15]

The fourth column in Table 2 includes a control for number of Score Sends in the regression analysis. Unlike the estimates in the third column, the coefficients in column four are conditional on colleges with the same enrollment and the same number of Score Sends. Therefore, any differences in the number of competitors are not driven by an institution being more or less popular, but rather, by students who apply to a larger set of colleges. The estimates in column four are somewhat attenuated, but remain substantively the same.

The last two columns in Table 2 replicate the regressions in columns three and four but include college random effects rather than clustering standard errors at the college level. These results are relatively robust to including college random effects. Only the coefficients on flagships and public flip signs, as does Barron's Special Category. This may in part be because the assumptions of the random effects model are not satisfied, namely that the college random effect is correlated with the independent variables when it should be uncorrelated.

As shown in Appendix Table 1 (columns 1 and 5), these results are robust to using only SAT dominant states and colleges where at least 50 percent of students submit an SAT score. This implies that the competition from ACT heavy colleges is orthogonal to our measure of competition, which in practice likely means one of two things: ACT heavy states and colleges do not compete with SAT heavy states and colleges or the level of competition between ACT colleges and SAT colleges does not measurably impact the way SAT colleges compete with one another.

4.2. Intensity of Competition

[15] In specifications that interacts public or flagship with enrollment, the sign of the coefficients are restored (positive) and the interactions are negative, suggesting that smaller public and flagship colleges tend to have more competitors than larger ones after accounting for the overall relationship with enrollment.

Examining the number of institutional competitors masks the fact that some competitors are more substantial than others. We define a competitor's level of intensity as the proportion of score sending students that overlap with a particular institution. Figure 2 shows the average number of competitors by intensity, where competitors are grouped into intensity bins that are five or 10 percentage points wide. On average, an institution has nearly 12 competitors with very modest 6-10 percent competition intensity (or score sending overlap). Although not shown in Figure 2, most competitors have 5 percent or less overlap, which is not surprising since many competitors only show up in a single student's Score Send set (the average number of competitors with intensity less than or equal to 5 percent is 716). Most remaining competitors are also low intensity and there is a precipitous decrease in competitor counts as competition intensity increases. In fact, once we examine competition intensity of greater than 30 percent, there is no more than one competitor in each intensity bin.

Next, we again return to equation (1) to test whether intensity of competition varies with a college's attributes. Some attributes will mechanically create variation across colleges. For example, conditional on enrollment size, if students randomly choose where to send their scores, we would expect larger colleges to have more competitors at lower intensities. Similar stories can be told regarding large applicant pools or low acceptance rate colleges. However, what is less clear is conditional on measures of size (and even selectivity), do colleges face different intensity of competition?

As shown in Table 3, despite having more overall competitors, private, selective, and NCAA colleges have numerous competitors with lower intensity (score sending overlap less than 20 percent). However, public colleges are more likely to have an intense competitor than private colleges, even as intense as 50 percent overlap. In particular, public institutions have an average of 0.14 more competitors with at least 50 percent score sending overlap than private institutions. This suggests that public and private colleges face a very different competitive landscape, one with few but intense competitors and the other with many but less intense competitors, respectively.[16]

5. Results on Top Five College Competitors

[16] Appendix Table 2 shows that results are qualitatively unchanged when using a poisson regression to account for the large number of zero competitors. Marginal effects, not shown, are similar in magnitude to Table 3.

We turn our analysis to the details of each college's five most intense competitors. Figure 3 displays the average intensity of the top five competitors. The Score Send overlap with the first competitor is 34 percent on average. The second competitor is, on average, almost 10 percentage points less intense and the intensity falls at a slower rate for the remaining three competitors. These unconditional statistics vary greatly with college attributes, as demonstrated by the estimates in the first column of Table 4, which correspond to equation (2) (observation is a college-year-competitor) and are generally consistent with the previous intensity results. Public and selective colleges face the most intense competition.

5.1. Distance of Top Five College Competitors

We next examine the relationship between college characteristics and the geographic distance to its major competitors. Hence, the outcome is distance in miles between a college and its major competitors. Results are presented in the second column of Table 4.

We find that the average distance between an institution and its top five competitors increases such that each subsequent competitor is located farther away from the institution. For instance, relative to the first competitor, the second competitor is located approximately 34 miles farther away, with the distance growing until the fifth competitor, which is located about 65 miles farther away than the main competitor.

The results also suggest that the most selective institutions compete on a more national level relative to the least selective institutions, whose competitors are located more locally. We find that the average distance between the most selective Barron's institutions and its competitors is about 120 miles greater than the average distance between the least selective institutions and its competitors. Further, we find that institutions with an engineering program or a hospital, or colleges that offer Master's or Ph.D.s have competitors that are located relatively far away compared to institutions who do not have these specialized programs. Flagships and HBCUs also compete with institutions that are located farther away.

Public and two-year institutions, on the other hand, have competitors that are located in closer proximity relative to private or the least selective four-year institutions, respectively. This

implies that college is rather local for the large fraction of students who attend these types of institutions.

The urbanicity of an institution's location is also related to competition; institutions located in urban and suburban areas have nearer competitors relative to institutions located in rural areas. Finally, colleges that are members of the NCAA as well as institutions that are larger in size, as measured by the enrollment, also compete more locally.

5.2. Characteristics of Top Five College Competitors

Next, we employ a similar methodology to that above where the outcome variables examined are characteristics of the top five competitors. Specifically, we separately regress dummy variables for whether a competitor institution is located within the same state, whether it is a public or a two-year institution, and its Barron's selectivity level on a college's characteristics.

As shown in the third column of Table 4, relative to the institution's main competitor, every subsequent competitor is less likely to be located within the same state, which is consistent with the above results on distance. Scrolling across the columns 4 through 10, the second through fifth competitors are also less likely than the main competitor to be a public institution or to be the most selective Barron's colleges. As expected, the most selective Barron's institutions are more likely to compete with other most selective, private institutions, and colleges that are located out-of-state. Similar to the distance analyses, this result suggests that these selective colleges are competing in a relatively national marketplace. Flagships are also less likely to have competitors that are located within the same state and are more likely to compete with selective institutions (Barron's category 3). Relative to private colleges, public institutions, on the other hand, are more likely to compete locally with institutions located within the same state as well as with other public institutions. Furthermore, unlike flagships, public institutions compete with less selective colleges.

To highlight a few other interesting patterns, institutions with specialized programs such as law schools, medical schools, or engineering programs are more likely to compete with the most selective colleges. While institutions with law schools compete within state and with other public institutions, colleges with hospitals and engineering programs are more likely to have out-of-state competitors. Institutions that are members of NCAA are more likely to compete with the most

selective, public institutions located within the state, while HBCUs tend to compete with out-of-state, private, and less selective institutions.

5.3. Student Subgroups

We also consider the extent to which an institution has the same set of competitors for different subgroups of students. For instance, in Table 5, a college's main competitor for white students (subgroup 1) is that same main competitor for black students (subgroup 2) only 39 percent of the time, on average. This percentage increases to 65 percent and 74 percent when calculating whether the institutions' main competitor for white students is among the top three or the top five competitors for black students, respectively. The overlap between competitors for white and Hispanic or white and Asian students occurs more frequently.

Competitor institutions tend to be more consistent across income and parental education subgroups with, for instance, about 55 percent of a college's main competitors for high income students also being listed as their main competitors for low income students. The overlap increases as we consider more similar subgroups of students. For example, about 70 percent of institutions have the same main competitor for middle- and low-income students. There is extreme overlap when considering not too distant SAT score categories and the top five competitors.

5.4. Changes Over Time

Next, we explore changes in average intensity and geographic distance of institutions' top five competitors over the sample period. Previous research has shown that the higher education market has become more competitive over the last half a century, at least for some institutions (Hoxby, 1997), and we can contribute new analyses for more recent years. We graphically examine whether and how the average intensity and distance of a college's competitors changes between 1996 and 2013. As displayed in Figure 4, we see that the average intensity of the top five competitors is relatively flat over time and any small fluctuations are mirrored by each competitor.

Figure 5 graphs the average distance of the first through fifth competitors over time. The first few competitors show a very slight increase in their distance from the college over time. However, the fourth and fifth competitors appear to see a more dramatic increase in distance,

particularly in more recent years.[17] These results indicate that institutions in our data face relatively similar competition in terms of intensity as they did two decades ago. However, for some institutions fourth and fifth competitors have become more distant which points to a slightly more national landscape.

6. Network Analysis

We now turn to our network analysis. Table 6 shows the number of times each college is a main competitor in 2013.[18] Recall, each college has a single main competitor, but over 71 percent are not a main competitor to another college, suggesting asymmetry in the market. Only 12 percent follow the symmetry of being the main competitor to one college. However, there are 140 colleges that are a main competitor to between two and six colleges and then a steadily declining set of colleges that are the main competitor to even more colleges.

While Table 6 shows the asymmetry of the market, it does not show which types of colleges are more likely to be a main competitor. Hence, we investigate that variation in Table 7, which again reverts to the specification in equation (1). The outcome in the first column is the degree of the college or the frequency with which an institution is listed as the main competitor. Since each college can only list five unique competitors, perfect symmetry in the market would imply that each college is only named once to each of the top five competitors spots. However, a rejection of symmetry yields differences in competition, popularity, and preferences. Empirically, symmetry would manifest itself in coefficient estimates equal to zero. A rejection of the null hypothesis implies that some colleges are more likely to be listed as a competitor than others and the market is asymmetric.

We find that the most selective Barron's institutions tend to be the main competitor on average, 1.1 times more than the least selective colleges. If we look across the columns, where we include whether the college is in the top three or top five competitors, the results increase to about

[17] We also more formally evaluate the figure within a regression framework and find that, relative to the first competitor, the average distance to the second or third competitors did not change over time while the distance to the fourth and fifth competitors had increased, but only slightly. With each additional year, the average distance to the fourth or fifth competitor has grown by about 1.6 miles. Other characteristics of colleges, including the most selective colleges, have relatively flat changes to the average distance of competitors.

[18] Earlier years have very similar patterns.

3.9 or 6.6 times more, respectively. Selective institutions (those grouped as Barron's Category 3) follow a similar pattern but the coefficients are smaller in magnitude.

In addition, institutions that offer Master's or Ph.D., HBCUs, and those with larger enrollments are the competitors to more colleges. Conversely, two-year institutions are considered competitors less frequently relative to the least selective four-year institutions as are NCAA colleges.[19, 20]

7. Conclusion

This paper documents the competitive landscape of higher education using Score Send overlap as a measure of competition. We have shown that, even today, there are many colleges that compete primarily with other relatively local or regional colleges. While this paper uses a new dataset to explore the competitive landscape of the market for higher education, it does not address several important issues related to admission and enrollment. An ideal dataset would include Score Sends, applications, and whether a student was admitted and where the student matriculated to determine student preferences on a national scale (i.e., Avery et al., 2013). This would allow researchers to construct a variety of measures of competition, determine which are correlated with one another, and better understand the college optimization problem in market conditions. But even with that information, it would still be worthwhile to examine how colleges' application pools overlap with one another. Score sending overlap allows us to capture students' choice sets on which various college ranking measures are based (e.g., admission rates). Avery et al. (2013) demonstrate that colleges engage in strategic behaviors to attract applicants and improve rankings. In that sense, score sending overlap provides another competitive metric beyond matriculation decisions. Relatedly, it would be interesting to see how Score Send overlap translates into application overlap. While the patterns outlined in this paper are very likely to hold at the application stage, there may be minor differences in magnitude and perhaps changes when considering applications from students who took the ACT rather than the SAT and the differential

[19] Although not shown, we find similar results when using a poisson regression.

[20] These results are also robust in a sample restricted to institutions in SAT dominant states only (see Appendix Table 1, columns 2-4) or within a sample of colleges where at least 50 percent of students submit an SAT score (see Appendix Table 1, columns 6-8).

conversion of Score Sends into applications by student and college characteristics (Smith, forthcoming).

There is much more research to be done in this area. Existing datasets make it difficult to evaluate how colleges manage the competition. How do colleges get students to apply and enroll at their respective institutions? This effort is certainly related to some combination of promotional materials, advertising, recruitment, campus visits, etc. It is also dependent upon improvements in rankings and growth in expenditures on education, infrastructure, research, and talent. While a few of these ideas have been explored with some depth, such as financial aid, it is both a complex optimization problem and a data gathering nightmare to account for all these factors. At the very least, further research should explore each factor of competition in isolation. It would also be interesting to know how these measures of competition stack up to colleges' beliefs on the competitive landscape, which may be a big influencer of decisions.

Most importantly, there is an unanswered question on how competition affects students. Does it decrease their price or increase their aid? Does it improve the educational experience or persistence and graduation rates? From a policy perspective, these are fundamental research questions worthy of consideration.

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Table 1: Summary Statistics
Number of Observations = 20,736 (1,152 per year)

Variable	Mean	Std. Dev.	Min	Max
Flagship	0.041	0.198	0	1
Public	0.461	0.498	0	1
Master or Ph.D. Offered	0.537	0.499	0	1
Law School	0.146	0.353	0	1
Business School	0.262	0.440	0	1
Hospital	0.040	0.195	0	1
Engineering Program	0.293	0.455	0	1
NCAA	0.720	0.449	0	1
HBCU	0.045	0.208	0	1
City	0.515	0.500	0	1
Suburb	0.264	0.441	0	1
Town	0.176	0.381	0	1
Rural	0.045	0.208	0	1
Barron's Category 1 and 2 (Most Selective)	0.147	0.354	0	1
Barron's Category 3	0.201	0.400	0	1
Barron's Category 4	0.351	0.477	0	1
Barron's Category 5 and 6 (Least Selective)	0.142	0.349	0	1
Barron's Special Category	0.057	0.231	0	1
Two-Year	0.103	0.304	0	1
Enrollment	1,132	1,192	1	9,953
Number of Score Sends	4,108	6,874	200	67,374
Number of Competitors	736	345	96	2,167
Avg. Intensity of Top 5 Competitors	22.6	11.0	2.4	93.1
Avg. Distance (miles) of Top 5 Competitors	146.6	247.0	0.0	2695.9
Main Competitor (freq.)	1.00	3.13	0	69
Among Top 3 Competitors (freq.)	2.98	7.11	0	101
Among Top 5 Competitors (freq.)	4.93	10.09	0	118

Notes: Observation is at the college-year level for the 1996-2013 high school graduating cohorts. Data come from College Board SAT test-takers and IPEDS. Enrollment is defined as the number of full-time, first-time, degree/certificate seeking undergraduates.

Table 2: Relationship Between a College's Number of Competitors and Its Attributes

	OLS				College Random Effects	
Flagship	128.758***	177.125***	-25.779	-13.619	166.266***	83.486***
	(42.136)	(31.259)	(27.037)	(29.972)	(26.914)	(24.562)
Public	52.596***	68.312***	-42.922***	-31.436**	41.880***	6.691
	(16.132)	(14.945)	(14.009)	(12.966)	(11.214)	(10.233)
Master or Ph.D. Offered	91.131***	93.237***	73.280***	48.480***	35.725***	32.962***
	(14.992)	(14.432)	(12.745)	(11.912)	(4.442)	(4.021)
Law School	43.150*	70.762***	51.676***	28.390*	68.288***	30.622***
	(24.450)	(21.258)	(16.353)	(15.438)	(9.052)	(8.223)
Business School	148.503***	138.980***	70.378***	49.099***	192.584***	112.570***
	(20.718)	(18.184)	(15.244)	(13.884)	(13.276)	(12.155)
Hospital	70.637**	76.778***	61.150**	7.049	-10.037*	-6.028
	(35.547)	(27.261)	(25.046)	(26.603)	(5.400)	(4.885)
Engineering Program	93.407***	120.526***	78.842***	63.833***	33.559***	22.738***
	(16.994)	(14.899)	(12.459)	(11.063)	(4.056)	(3.674)
NCAA	154.364***	133.029***	102.187***	105.942***	32.964***	33.048***
	(15.528)	(16.273)	(14.689)	(13.281)	(3.208)	(2.902)
HBCU	96.357***	81.397**	102.712***	86.244***	115.110***	97.817***
	(35.155)	(33.075)	(30.326)	(27.682)	(24.635)	(22.458)
City	52.847**	60.608***	50.928***	51.412***	70.784***	59.523***
	(23.395)	(22.294)	(18.368)	(17.870)	(24.073)	(21.947)
Suburban	34.042	8.212	12.058	17.335	8.260	12.847
	(23.744)	(22.575)	(18.686)	(18.068)	(24.842)	(22.647)
Town	-3.014	33.919	45.933**	37.826**	44.493*	36.356
	(24.508)	(22.859)	(18.780)	(18.390)	(25.411)	(23.166)
Barron's Category 1 and 2 (Most Selective)	388.047***	380.875***	328.501***	195.022***	389.991***	207.623***
	(24.145)	(21.957)	(18.829)	(18.527)	(18.468)	(17.046)
Barron's Category 3	209.348***	236.464***	205.489***	166.293***	235.159***	176.600***
	(22.706)	(20.484)	(17.279)	(16.178)	(17.396)	(15.877)
Barron's Category 4	120.157***	120.852***	104.942***	90.417***	132.484***	103.978***
	(19.361)	(17.262)	(15.043)	(13.948)	(14.609)	(13.318)
Barron's Special Category	136.424***	103.547***	78.948**	62.847**	-141.302***	-111.892***
	(35.047)	(34.271)	(31.281)	(28.846)	(16.825)	(15.308)
Two-Year	-73.064***	-122.902***	-198.537***	-156.977***	-132.142***	-113.048***
	(25.470)	(25.889)	(23.155)	(21.276)	(16.357)	(14.880)
Enrollment/100			12.318***	5.954***	3.396***	0.589***
			(0.640)	(0.719)	(0.171)	(0.160)
Number of Score Sends				0.019***		0.023***
				(0.002)		(0.000)
State Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
Observations	20,736	20,736	20,736	20,736	20,736	20,736
R-squared	0.611	0.694	0.762	0.805		

Notes: Estimated using OLS. Observation is at the college-year level for the 1996-2013 high school graduating cohorts. Standard errors are in parentheses and clustered at the college level in OLS specifications. *** means significant at 1% level, ** at 5%, and * at 10%. For each college, competitors are defined to be the colleges that have the most number of Score Sends in common. Year fixed effects are included in all regressions. Omitted variables are Barron's least selective colleges and rural dummies.

Table 3: Relationship Between a College's Number of Competitors and Its Attributes by Intensity

	Number of Competitors with Intensity							
	0-5	*6-10*	*11-15*	*16-20*	*21-30*	*31-40*	*41-50*	*>50*
Flagship	-29.824	4.339***	1.111***	-0.065	-0.255	-0.490***	-0.384***	-0.210***
	(27.063)	(0.775)	(0.354)	(0.184)	(0.159)	(0.092)	(0.065)	(0.060)
Public	-39.861***	-2.695***	-0.951***	-0.309***	0.165*	0.385***	0.205***	0.140***
	(14.040)	(0.344)	(0.153)	(0.094)	(0.090)	(0.048)	(0.029)	(0.022)
Master or Ph.D. Offered	73.596***	-0.781**	0.062	0.059	0.278***	0.039	0.012	0.014
	(12.766)	(0.322)	(0.150)	(0.091)	(0.084)	(0.048)	(0.027)	(0.019)
Law School	50.424***	0.247	0.528***	0.168	0.121	0.091	0.117***	-0.018
	(16.303)	(0.418)	(0.197)	(0.127)	(0.112)	(0.065)	(0.041)	(0.033)
Business School	69.781***	0.382	0.043	0.032	0.107	0.124**	-0.057	-0.033
	(15.241)	(0.363)	(0.164)	(0.102)	(0.101)	(0.058)	(0.040)	(0.028)
Hospital	60.655**	0.516	-0.019	0.028	-0.117	-0.074	0.059	0.102
	(24.991)	(0.801)	(0.443)	(0.197)	(0.170)	(0.073)	(0.067)	(0.069)
Engineering Program	79.846***	-0.617*	-0.150	-0.077	-0.029	-0.078	-0.030	-0.025
	(12.490)	(0.354)	(0.160)	(0.093)	(0.092)	(0.049)	(0.028)	(0.020)
NCAA	99.220***	1.746***	0.414***	0.264***	0.371***	0.150***	0.033	-0.011
	(14.667)	(0.317)	(0.140)	(0.086)	(0.089)	(0.050)	(0.029)	(0.020)
HBCU	100.952***	1.143***	0.386*	0.247*	0.174	-0.017	-0.130***	-0.045
	(30.338)	(0.432)	(0.223)	(0.129)	(0.152)	(0.093)	(0.046)	(0.038)
City	50.752***	0.088	0.037	-0.070	-0.082	0.075	0.073*	0.055
	(18.422)	(0.696)	(0.245)	(0.179)	(0.149)	(0.073)	(0.044)	(0.041)
Suburban	11.857	-0.068	0.128	-0.103	0.032	0.095	0.070	0.047
	(18.731)	(0.735)	(0.261)	(0.188)	(0.157)	(0.076)	(0.046)	(0.043)
Town	45.723**	-0.098	0.163	0.048	-0.009	0.103	-0.006	0.009
	(18.850)	(0.747)	(0.255)	(0.190)	(0.162)	(0.080)	(0.046)	(0.041)
Barron's Category 1 and 2 (Most Selective)	313.923***	9.625***	2.923***	1.100***	0.659***	0.157**	0.059	0.055*
	(18.867)	(0.664)	(0.275)	(0.176)	(0.153)	(0.079)	(0.043)	(0.031)
Barron's Category 3	203.463***	2.077***	0.052	-0.211*	0.013	0.021	0.037	0.038
	(17.293)	(0.400)	(0.174)	(0.113)	(0.115)	(0.064)	(0.043)	(0.031)
Barron's Category 4	104.711***	0.383	-0.139	-0.067	0.077	-0.015	-0.006	-0.003
	(15.038)	(0.283)	(0.135)	(0.095)	(0.095)	(0.055)	(0.032)	(0.024)
Barron's Special Category	79.145**	-0.258	0.032	-0.123	0.191	-0.021	-0.047	0.028
	(31.337)	(0.544)	(0.225)	(0.163)	(0.160)	(0.100)	(0.048)	(0.040)
Two-Year	-199.027***	0.142	0.140	-0.021	0.145	-0.081	-0.098*	0.264***
	(23.125)	(0.474)	(0.217)	(0.147)	(0.154)	(0.090)	(0.054)	(0.054)
Enrollment/100	12.378***	-0.031*	-0.014**	-0.006	-0.011***	-0.002	0.003*	0.002
	(0.639)	(0.017)	(0.007)	(0.004)	(0.004)	(0.002)	(0.002)	(0.001)
Observations	20,736	20,736	20,736	20,736	20,736	20,736	20,736	20,736
R-squared	0.757	0.534	0.360	0.214	0.184	0.150	0.155	0.243

Notes: Estimated using OLS. Observation is at the college-year level for the 1996-2013 high school graduating cohorts. Standard errors are clustered at the college level and are presented in parentheses. *** means significant at 1% level, ** at 5%, and * at 10%. For each college, competitors are defined to be the colleges that have the most number of Score Sends in common. Year and state fixed effects are included in all regressions. Omitted variables are Barron's least selective colleges and rural dummies.

Table 4: Characteristics of Top 5 College Competitors

	Characteristics of Competitors									
College Attributes	Intensity (pct)	Distance (miles)	Within State	Public	Barron's Most Selective Category	Barron's Category 3	Barron's Category 4	Barron's Least Selective Category	Barron's Special Category	Two-Year
Flagship	-5.957***	35.081***	-0.227***	-0.007	-0.010	0.089***	-0.076***	-0.018***	0.017***	-0.002
	(0.244)	(5.685)	(0.009)	(0.008)	(0.009)	(0.007)	(0.008)	(0.003)	(0.002)	(0.001)
Public	4.521***	-30.553***	0.108***	0.285***	-0.039***	-0.052***	0.085***	0.016***	-0.017***	0.007***
	(0.105)	(2.718)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.002)	(0.002)	(0.001)
Master or Ph.D. Offered	1.125***	16.558***	0.001	-0.004	-0.015***	0.019***	0.008**	-0.004*	-0.008***	0.000
	(0.106)	(2.771)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.002)	(0.001)	(0.001)
Law School	1.206***	6.110*	0.022***	0.058***	0.039***	-0.045***	-0.002	0.018***	-0.012***	0.001
	(0.137)	(3.213)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Business School	0.173	-19.670***	-0.002	-0.031***	0.006	0.022***	-0.026***	-0.010***	0.008***	-0.000
	(0.116)	(2.824)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Hospital	0.697***	55.176***	-0.032***	0.002	0.071***	-0.027***	-0.031***	-0.005**	-0.009***	0.001**
	(0.239)	(8.053)	(0.010)	(0.009)	(0.008)	(0.007)	(0.007)	(0.002)	(0.002)	(0.001)
Engineering Program	-1.234***	55.626***	-0.101***	0.010**	0.036***	-0.006*	-0.022***	-0.009***	0.004***	-0.003***
	(0.099)	(2.965)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.001)	(0.000)
NCAA	1.432***	-58.380***	0.086***	0.097***	0.046***	-0.007*	0.005	-0.015***	-0.025***	-0.003***
	(0.130)	(4.058)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.001)
HBCU	-0.878***	42.713***	-0.187***	-0.172***	-0.102***	-0.232***	0.162***	0.170***	-0.003**	0.005***
	(0.192)	(3.850)	(0.007)	(0.007)	(0.005)	(0.005)	(0.008)	(0.007)	(0.001)	(0.002)
City	1.149***	-41.100***	-0.003	-0.030***	0.025***	0.001	-0.056***	-0.003	0.023***	0.010***
	(0.175)	(5.828)	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)	(0.004)	(0.002)	(0.002)
Suburban	1.205***	-39.201***	-0.012	-0.025***	0.013**	0.037***	-0.054***	-0.010**	0.004*	0.010***
	(0.179)	(6.013)	(0.008)	(0.008)	(0.006)	(0.006)	(0.007)	(0.004)	(0.002)	(0.002)
Town	0.466***	-8.319	-0.016*	0.006	0.034***	-0.019***	-0.032***	-0.003	0.016***	0.004**
	(0.180)	(5.784)	(0.008)	(0.008)	(0.007)	(0.006)	(0.007)	(0.004)	(0.002)	(0.001)
Barron's Category 1 and 2 (Most Selective)	2.293***	119.452***	-0.273***	-0.302***	0.521***	-0.100***	-0.336***	-0.066***	-0.016***	-0.003***
	(0.164)	(4.643)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.003)	(0.001)	(0.001)
Barron's Category 3	0.202	7.519**	-0.051***	-0.086***	0.199***	0.033***	-0.159***	-0.056***	-0.014***	-0.003***
	(0.148)	(3.326)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.001)	(0.001)
Barron's Category 4	-0.241**	1.283	-0.004	-0.015***	0.030***	0.041***	-0.040***	-0.029***	-0.001	-0.001
	(0.121)	(2.764)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)	(0.003)	(0.001)	(0.001)
Barron's Special Category	-0.036	85.542***	-0.169***	-0.139***	0.029***	-0.056***	-0.163***	-0.045***	0.235***	0.001
	(0.237)	(8.028)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.005)	(0.009)	(0.002)
Two-Year	2.255***	-40.033***	0.013**	-0.020***	0.046***	-0.007	-0.064***	-0.028***	0.004	0.050***
	(0.212)	(4.439)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.004)	(0.003)	(0.003)
Second Competitor	-8.763***	33.851***	-0.052***	-0.032***	-0.013***	-0.028***	0.032***	0.005***	0.001	0.003***
	(0.062)	(1.695)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Third Competitor	-13.492***	54.386***	-0.100***	-0.067***	-0.023***	-0.041***	0.036***	0.017***	0.004***	0.008***
	(0.073)	(1.946)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Fourth Competitor	-16.697***	58.989***	-0.125***	-0.101***	-0.033***	-0.047***	0.038***	0.027***	0.003**	0.013***
	(0.081)	(1.886)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Fifth Competitor	-19.103***	64.637***	-0.147***	-0.144***	-0.037***	-0.048***	0.042***	0.028***	0.003***	0.013***
	(0.086)	(1.856)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Enrollment/100	-0.013**	-0.491***	-0.000	-0.000	-0.001***	0.001***	0.000	-0.000	-0.000	-0.000***
	(0.005)	(0.126)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	103,680	103,680	103,680	103,680	103,680	103,680	103,680	103,680	103,680	103,680
R-squared	0.559	0.179	0.379	0.297	0.252	0.096	0.153	0.096	0.193	0.052

Notes: Estimated using OLS. Observation is at the college-year-competitor level for the 1996-2013 high school graduating cohorts. Standard errors are clustered at the college-year level and are presented in parentheses. *** means significant at 1% level, ** at 5%, and * at 10%. For each college, competitors are defined to be the colleges that have the most number of Score Sends in common. Year and state fixed effects are included in all regressions. Omitted variables are Barron's least selective colleges, first competitor and rural dummies.

Table 5: Degree of Symmetric Competition Across Subgroups

Subgroup 1	Subgroup 2	Main Competitor	Top 3 Competitors	Top 5 Competitors
Race				
White	Black	0.394	0.647	0.744
White	Hispanic	0.481	0.729	0.814
White	Asian	0.461	0.701	0.786
Black	Hispanic	0.420	0.650	0.728
Income				
High	Low	0.548	0.797	0.875
High	Middle	0.670	0.894	0.944
Middle	Low	0.702	0.920	0.962
Parent's Education				
Bachelor's	High School of Less	0.600	0.844	0.909
Bachelor's	Some College	0.703	0.918	0.960
Some College	High School of Less	0.715	0.915	0.955
SAT Score				
More than 1300	Less than 1000	0.283	0.501	0.612
1200s	1000s	0.571	0.819	0.895
1000s	Less than 1000	0.617	0.890	0.950
1100s	1000s	0.701	0.919	0.962
1200s	1100s	0.675	0.894	0.942
More than 1300	1200s	0.564	0.788	0.855

Notes: Competitor for each subgroup at each college in each year is calculated separately for the 1996-2013 high school graduating cohorts. All estimates are the fraction of observations that subgroup 2 has the same competitor as subgroup 1's main competitor. For top 3 and top 5 competitors, the estimate is the fraction of observations that subgroup 1's main competitor is among the top 3 and top 5 competitors.

Table 6: Frequency of Being Considered a Main Competitor

Number of Times a Main Competitor	Freq.	Percent
0	821	71.27
1	141	12.24
2	56	4.86
3	36	3.13
4	24	2.08
5	11	0.95
6	13	1.13
7	9	0.78
8	9	0.78
9	5	0.43
10	9	0.78
11	2	0.17
12	4	0.35
13	3	0.26
14	2	0.17
15	1	0.09
17	1	0.09
20	2	0.17
21	2	0.17
37	1	0.09
Total	1,152	100

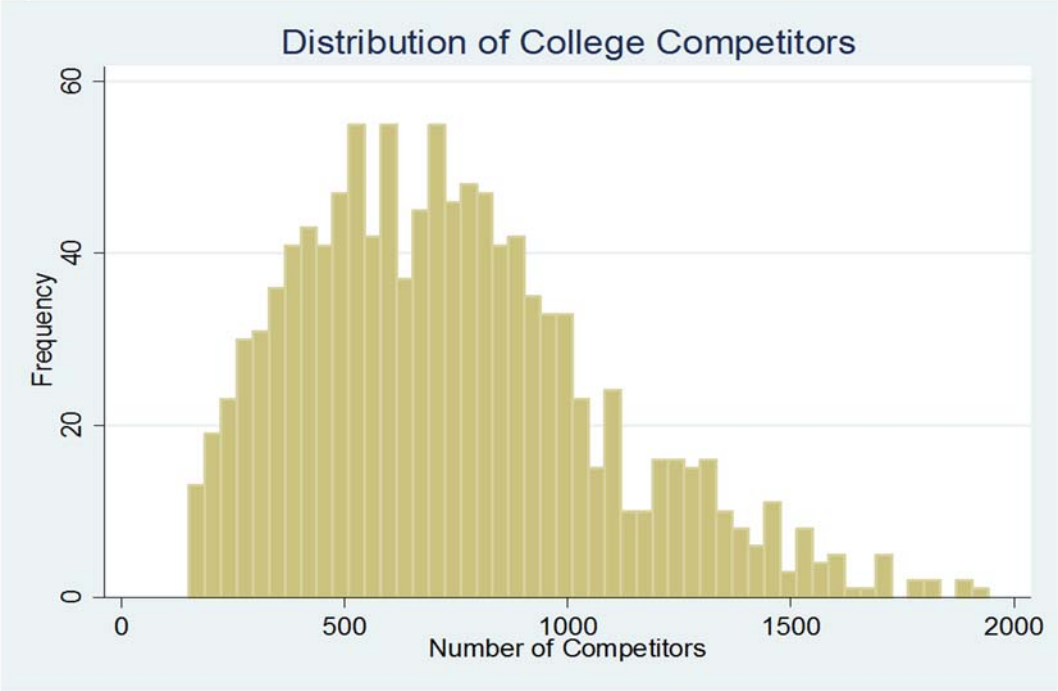
Notes: Sample only includes the 2013 high school graduating cohort.

Table 7: Network Analysis

	Main Competitor	Among Top 3 Competitors	Among Top 5 Competitors
Flagship	3.805***	3.533	1.620
	(1.221)	(2.189)	(2.714)
Public	-0.317*	-0.134	0.272
	(0.165)	(0.378)	(0.545)
Master or Ph.D. Offered	0.207**	0.776***	1.561***
	(0.101)	(0.222)	(0.318)
Law School	-0.466	-0.544	-0.003
	(0.494)	(0.855)	(1.052)
Business School	0.143	0.433	0.799
	(0.193)	(0.434)	(0.593)
Hospital	0.052	-0.060	0.222
	(0.512)	(1.009)	(1.410)
Engineering Program	0.060	-0.324	-0.424
	(0.154)	(0.335)	(0.457)
NCAA	-0.418***	-0.927***	-1.081***
	(0.130)	(0.277)	(0.378)
HBCU	0.604***	1.315***	1.676**
	(0.203)	(0.442)	(0.650)
City	0.086	0.173	0.146
	(0.160)	(0.408)	(0.569)
Suburban	-0.158	-0.170	-0.240
	(0.178)	(0.424)	(0.590)
Town	0.053	0.289	0.519
	(0.161)	(0.410)	(0.578)
Barron's Category 1 and 2 (Most Selective)	1.147***	3.916***	6.565***
	(0.272)	(0.565)	(0.766)
Barron's Category 3	0.582***	2.040***	3.428***
	(0.178)	(0.392)	(0.563)
Barron's Category 4	0.231*	1.048***	1.824***
	(0.124)	(0.281)	(0.396)
Barron's Special Category	0.163	0.626	1.089*
	(0.169)	(0.429)	(0.621)
Two-Year	-1.150***	-3.496***	-5.165***
	(0.195)	(0.517)	(0.734)
Enrollment/100	0.144***	0.399***	0.574***
	(0.017)	(0.043)	(0.058)
Observations	20,736	20,736	20,736
R-squared	0.460	0.550	0.589

Notes: Estimated using OLS. Observation is at the college-year level for the 1996-2013 high school graduating cohorts. Standard errors are clustered at the college level and are presented in parentheses. *** means significant at 1% level, ** at 5%, and * at 10%. For each college, competitors are defined to be the colleges that have the most number of Score Sends in common. Year and state fixed effects are included in all regressions. Omitted variables are Barron's least selective colleges and rural dummies.

Figure 1.



Notes: The number of competitors for each college is the average across 1996-2013 cohorts.

Figure 2.

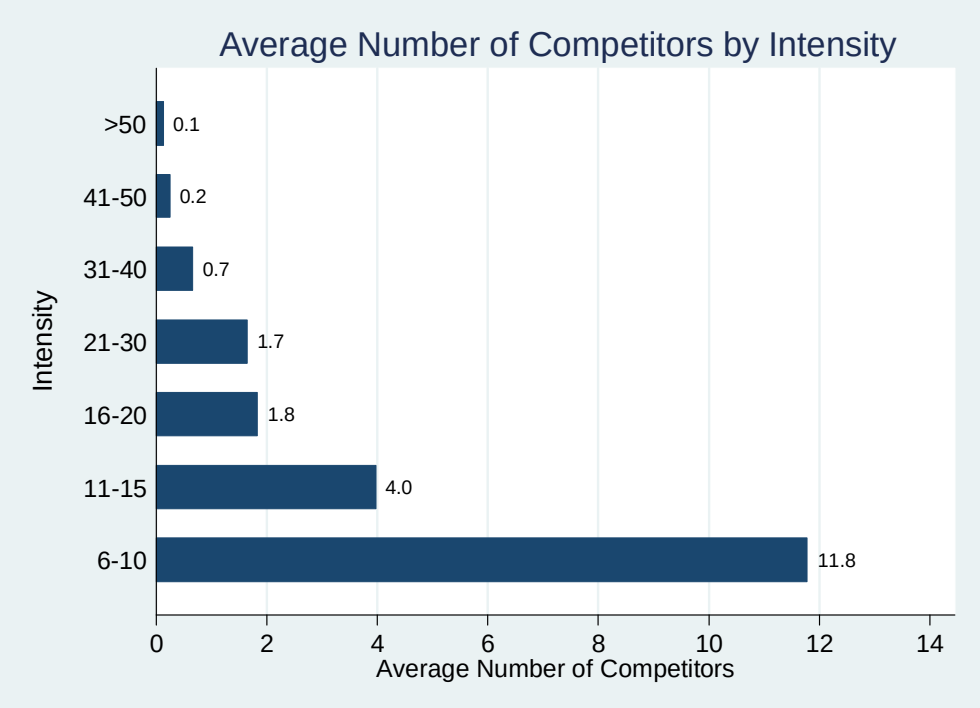


Figure 3.

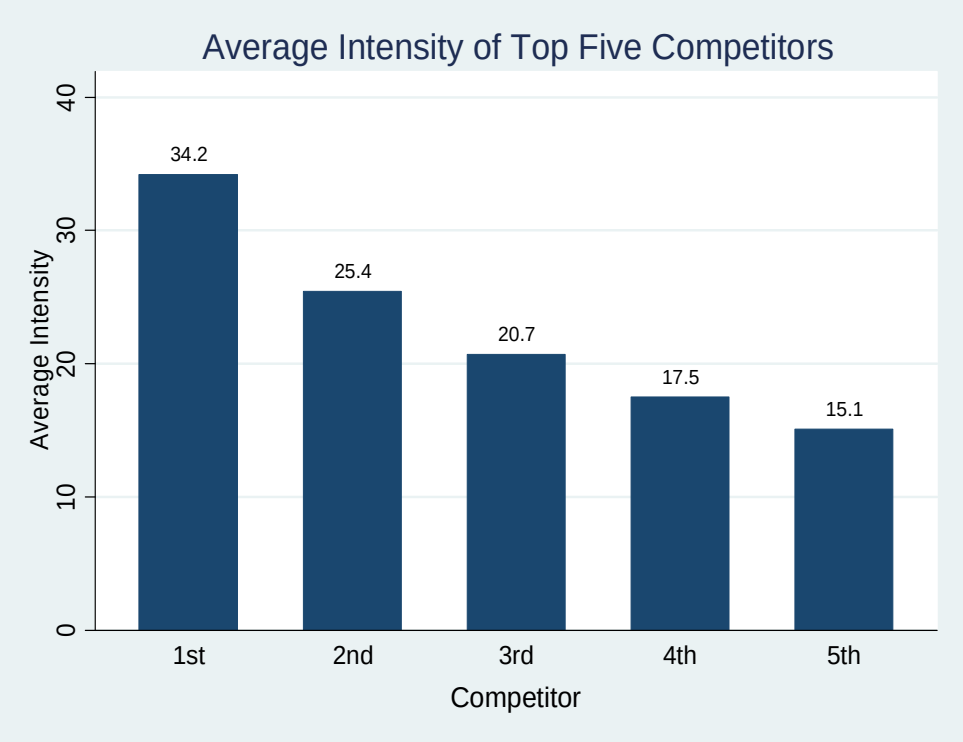


Figure 4.

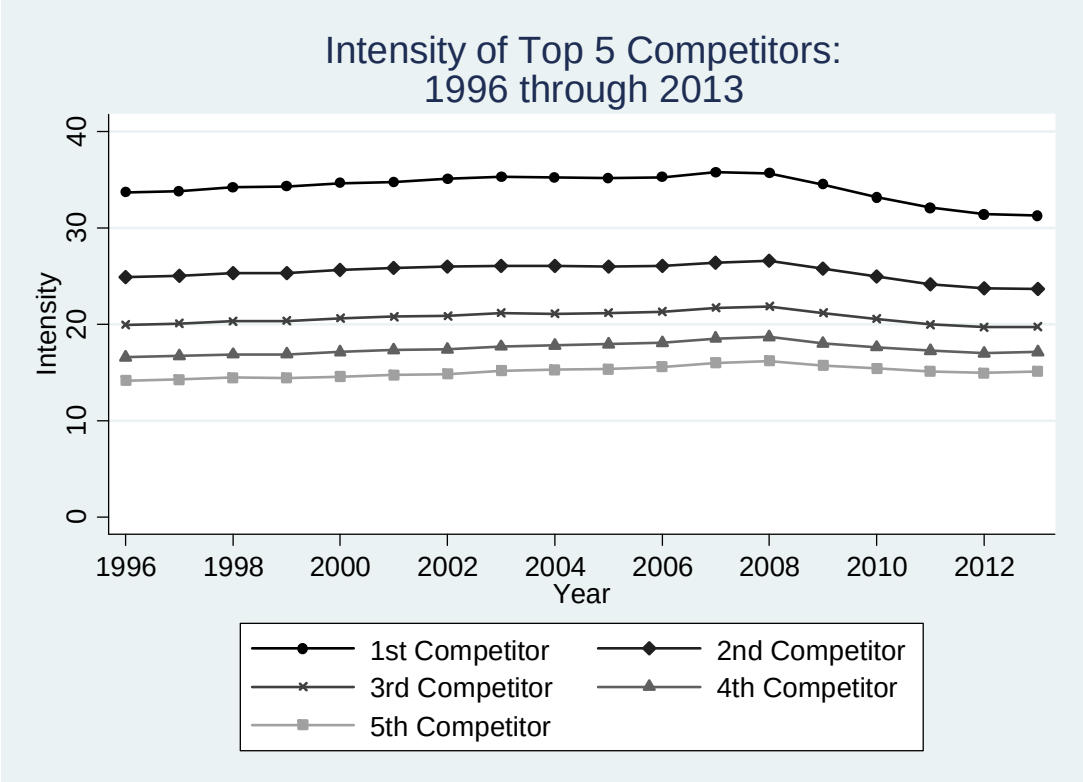
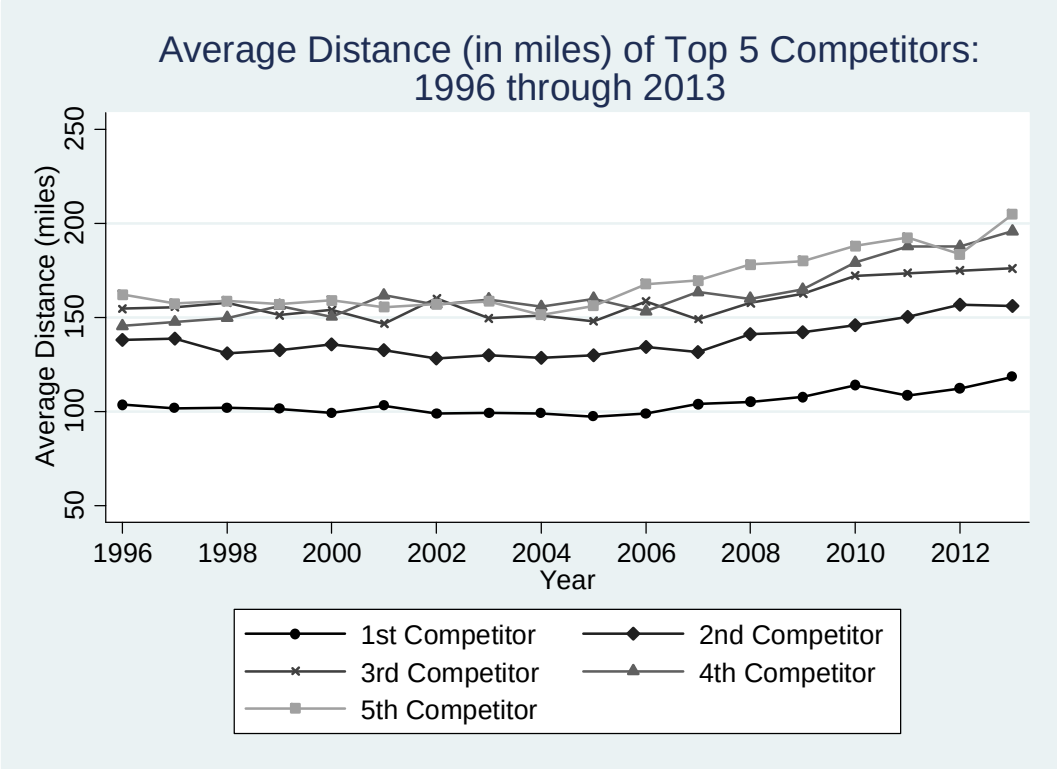


Figure 5.


Average Distance (in miles) of Top 5 Competitors: 1996 through 2013
Average Distance (miles)
50
100
150
200
250
1996
1998
2000
2002
2004
2006
2008
2010
2012
Year
1st Competitor
2nd Competitor
3rd Competitor
4th Competitor
5th Competitor

Appendix

Appendix Table 1: Robusteness Checks

	Institutions in SAT Dominant States Only				Institutions Where at Least 50% of Students Submit an SAT Score			
	Number of Competitors	Network Analysis			Number of Competitors	Network Analysis		
	OLS	Main Competitor	Among Top 3 Competitors	Among Top 5 Competitors	OLS	Main Competitor	Among Top 3 Competitors	Among Top 5 Competitors
Flagship	-52.830*	6.958***	9.273***	8.682**	-106.736***	5.223***	5.332*	3.414
	(30.967)	(2.143)	(3.421)	(3.854)	(32.368)	(1.805)	(2.887)	(3.276)
Public	-13.521	-0.332*	-0.217	0.250	-0.898	-0.581***	-0.764*	-0.419
	(15.167)	(0.200)	(0.423)	(0.585)	(15.591)	(0.225)	(0.456)	(0.614)
Master or Ph.D. Offered	73.367***	0.107	0.594***	1.372***	64.006***	-0.104	0.083	0.686*
	(13.676)	(0.100)	(0.225)	(0.317)	(14.350)	(0.114)	(0.263)	(0.365)
Law School	63.632***	-0.194	0.205	1.091	53.158***	-0.473	-0.703	-0.237
	(19.791)	(0.553)	(0.929)	(1.118)	(19.626)	(0.613)	(1.004)	(1.152)
Business School	79.359***	0.100	0.163	0.540	63.673***	-0.094	-0.295	-0.200
	(17.042)	(0.207)	(0.475)	(0.645)	(16.765)	(0.224)	(0.505)	(0.667)
Hospital	69.585**	0.284	0.064	0.727	39.355	0.214	-0.008	0.533
	(33.542)	(0.787)	(1.452)	(1.930)	(34.427)	(0.816)	(1.491)	(1.982)
Engineering Program	85.568***	0.115	-0.305	-0.345	71.566***	-0.103	-0.954**	-1.338**
	(14.240)	(0.197)	(0.389)	(0.514)	(14.320)	(0.226)	(0.434)	(0.560)
NCAA	127.661***	-0.305**	-0.705***	-0.717*	114.487***	-0.613***	-1.401***	-1.680***
	(16.399)	(0.125)	(0.273)	(0.368)	(15.401)	(0.163)	(0.344)	(0.450)
HBCU	64.664*	0.467**	0.908*	0.861	98.815**	0.778**	1.558**	1.578
	(33.727)	(0.235)	(0.513)	(0.742)	(40.130)	(0.336)	(0.700)	(0.962)
City	55.924***	-0.093	-0.252	-0.389	88.456***	-0.163	-0.773	-1.369
	(20.981)	(0.159)	(0.405)	(0.577)	(24.279)	(0.266)	(0.663)	(0.919)
Suburban	16.681	-0.427**	-0.699	-0.915	55.736**	-0.486	-1.040	-1.578*
	(20.983)	(0.216)	(0.457)	(0.626)	(25.078)	(0.319)	(0.687)	(0.934)
Town	35.646*	-0.181	-0.287	-0.310	53.850**	-0.307	-0.917	-1.417
	(20.826)	(0.160)	(0.403)	(0.577)	(24.124)	(0.263)	(0.640)	(0.882)
Barron's Category 1 and 2 (Most Selective)	304.689***	0.478*	2.360***	4.334***	308.274***	0.523*	2.519***	4.738***
	(19.456)	(0.250)	(0.544)	(0.723)	(21.002)	(0.298)	(0.609)	(0.796)
Barron's Category 3	204.788***	0.361*	1.520***	2.689***	196.856***	0.348	1.545***	2.677***
	(18.370)	(0.214)	(0.437)	(0.610)	(18.887)	(0.223)	(0.470)	(0.641)
Barron's Category 4	106.652***	0.261**	1.078***	1.857***	100.816***	0.238	1.038***	1.774***
	(15.779)	(0.130)	(0.307)	(0.429)	(16.490)	(0.153)	(0.358)	(0.483)
Barron's Special Category	95.540***	0.149	0.627	1.081	134.992***	0.112	0.475	0.813
	(33.637)	(0.186)	(0.477)	(0.681)	(43.190)	(0.253)	(0.593)	(0.799)
Two-Year	-195.399***	-1.334***	-4.176***	-6.145***	-87.578**	-0.601*	-1.651**	-2.245**
	(25.040)	(0.208)	(0.567)	(0.797)	(39.495)	(0.321)	(0.750)	(0.921)
Enrollment/100	12.887***	0.168***	0.493***	0.715***	14.875***	0.220***	0.617***	0.888***
	(0.786)	(0.021)	(0.050)	(0.065)	(0.949)	(0.026)	(0.053)	(0.068)
Observations	16,272	16,272	16,272	16,272	12,636	12,636	12,636	12,636
R-squared	0.785	0.531	0.644	0.690	0.783	0.552	0.676	0.728

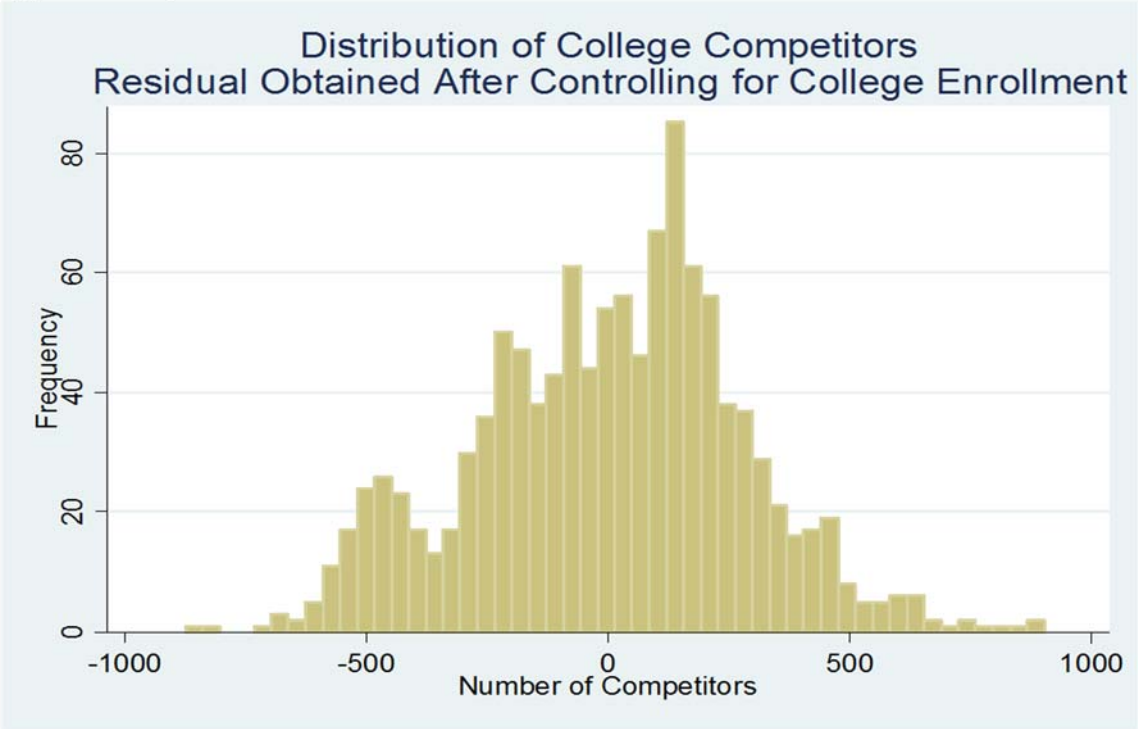
Notes: Estimated using OLS. Observation is at the college-year level for the 1996-2013 high school graduating cohorts. Standard errors are clustered at the college level and are presented in parentheses. *** means significant at 1% level, ** at 5%, and * at 10%. For each college, competitors are defined to be the colleges that have the most number of Score Sends in common. Year and state fixed effects are included in all regressions. Omitted variables are Barron's least selective colleges and rural dummies.

Appendix Table 2: Poisson Regression
Relationship Between a College's Number of Competitors and Its Attributes by Intensity

	Number of Competitors with Intensity							
	0-5	*6-10*	*11-15*	*16-20*	*21-30*	*31-40*	*41-50*	*>50*
Flagship	-0.070**	0.407***	0.359***	-0.026	-0.185	-0.886***	-1.640***	-1.906***
	(0.031)	(0.054)	(0.086)	(0.117)	(0.115)	(0.199)	(0.381)	(0.692)
Public	-0.029	-0.252***	-0.256***	-0.165***	0.108**	0.576***	0.831***	1.469***
	(0.020)	(0.030)	(0.040)	(0.052)	(0.053)	(0.070)	(0.112)	(0.219)
Master or Ph.D. Offered	0.103***	-0.061**	0.016	0.029	0.171***	0.060	0.062	0.332
	(0.019)	(0.026)	(0.037)	(0.047)	(0.050)	(0.076)	(0.125)	(0.228)
Law School	0.054***	0.028	0.125***	0.074	0.056	0.153	0.492***	-0.136
	(0.019)	(0.033)	(0.046)	(0.065)	(0.063)	(0.094)	(0.133)	(0.258)
Business School	0.080***	0.024	-0.009	0.011	0.067	0.188**	-0.158	-0.117
	(0.020)	(0.030)	(0.043)	(0.055)	(0.056)	(0.078)	(0.141)	(0.230)
Hospital	0.043*	0.055	0.011	0.008	-0.099	-0.170	0.166	0.690*
	(0.026)	(0.050)	(0.089)	(0.094)	(0.103)	(0.119)	(0.201)	(0.371)
Engineering Program	0.099***	-0.046*	-0.036	-0.041	-0.018	-0.130*	-0.160	-0.230
	(0.016)	(0.028)	(0.038)	(0.048)	(0.053)	(0.074)	(0.111)	(0.203)
NCAA	0.194***	0.150***	0.099***	0.140***	0.252***	0.281***	0.168	-0.263
	(0.025)	(0.028)	(0.037)	(0.050)	(0.061)	(0.088)	(0.134)	(0.222)
HBCU	0.137***	0.111***	0.112*	0.145**	0.090	-0.043	-0.606**	-0.632
	(0.042)	(0.040)	(0.063)	(0.071)	(0.084)	(0.129)	(0.259)	(0.678)
City	0.091**	-0.004	0.002	-0.046	-0.053	0.142	0.298	0.356
	(0.037)	(0.059)	(0.065)	(0.098)	(0.096)	(0.142)	(0.239)	(0.400)
Suburban	0.042	-0.019	0.020	-0.068	0.012	0.164	0.255	0.310
	(0.037)	(0.062)	(0.068)	(0.102)	(0.099)	(0.145)	(0.242)	(0.391)
Town	0.072*	-0.021	0.034	0.023	-0.011	0.184	0.001	-0.018
	(0.038)	(0.064)	(0.068)	(0.104)	(0.104)	(0.152)	(0.260)	(0.440)
Barron's Category 1 and 2 (Most Selective)	0.389***	0.628***	0.548***	0.455***	0.362***	0.251**	0.253	0.438
	(0.028)	(0.040)	(0.051)	(0.072)	(0.081)	(0.119)	(0.185)	(0.346)
Barron's Category 3	0.291***	0.192***	0.022	-0.120*	-0.003	0.020	0.127	0.249
	(0.027)	(0.035)	(0.047)	(0.064)	(0.073)	(0.098)	(0.170)	(0.308)
Barron's Category 4	0.168***	0.047*	-0.035	-0.034	0.049	-0.021	0.005	-0.105
	(0.025)	(0.028)	(0.038)	(0.053)	(0.057)	(0.080)	(0.135)	(0.258)
Barron's Special Category	0.107*	-0.014	0.005	-0.073	0.138	-0.026	-0.278	0.108
	(0.060)	(0.054)	(0.062)	(0.096)	(0.102)	(0.164)	(0.226)	(0.396)
Two-Year	-0.488***	-0.066	-0.002	-0.038	0.124	-0.019	-0.234	0.662*
	(0.045)	(0.049)	(0.065)	(0.089)	(0.099)	(0.131)	(0.199)	(0.350)
Enrollment/100	0.012***	-0.003*	-0.004**	-0.004	-0.007***	-0.004	0.005	0.008
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.006)
Observations	20,736	20,736	20,736	20,736	20,736	20,736	20,736	20,736

Notes: Observation is at the college-year level for the 1996-2013 high school graduating cohorts. Standard errors are clustered at the college level and are presented in parentheses. *** means significant at 1% level, ** at 5%, and * at 10%. For each college, competitors are defined to be the colleges that have the most number of Score Sends in common. Year and state fixed effects are included in all regressions. Omitted variables are Barron's least selective colleges and rural dummies.

Appendix Figure 1.



Notes: The number of competitors for each college is the average across 1996-2013 cohorts.