The Effect of College Applications on Enrollment

Jonathan Smith*

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Abstract

This paper investigates determinants of the number of four-year colleges to which students apply and how the number of applications affects their probabilities of enrollment. To estimate the effect on enrollment, I use a novel instrument: the adoption rate of the Common Application near a student's home. I find that applying to one additional college increases students' likelihood of enrollment, but only for those applying to very few colleges. Going from one to two applications and two to three applications increases students' probabilities of enrollment by 40% and 10%, respectively. This is partially due to the increase in the probability of being accepted to some college but also due to the increase in the probability of choosing to enroll, conditional on being accepted.

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*The College Board - Advocacy & Policy Center. E-mail: jsmith@collegeboard.org

1 Introduction

Increasing college enrollment rates is a major policy goal in the United States. For example, the 2010 federal budget set aside $2.5 billion to "evaluate programs aimed at increasing college enrollment and graduation."[1] However, approximately 25% of students who apply to four-year colleges do not enroll in one.[2] Over half of the applicants who do not enroll are accepted to at least one college. In this study, I examine how the number of colleges to which students apply affects their enrollment decisions. I also investigate several determinants of the number of applications.

To investigate the number of college applications' effect on enrollment, I use a sample of U.S. students who, in 2004, applied to at least one four-year bachelor-degree granting college directly out of high school. As Figure 1 illustrates, students who apply to more colleges have higher enrollment rates. However, it is unclear whether this is a causal relation.

There are at least two theoretical reasons that a student's choice of applications causally affects college enrollment, which are each plotted in Figure 1. First, it affects the overall probability of being accepted to college. All else equal, the more college applications, the greater the probability of being accepted to at least one college. The dashed red line shows students applying to one, two, and three colleges are rejected from all colleges to which they apply 35%, 11%, and 5% of the time, respectively.

Second, beyond the uncertainty of whether a student receives an offer of acceptance, there is uncertainty in the utility each college will provide. One such source of uncertainty may include financial issues, such as the amount of grants received, work-study offers, or loans, all of which are typically unknown at the time of application. There is also uncertainty in the quality of the student-college match. Students may have never seen the campus or at the very least, not have all the information about their potential college experience, such as programs of study, the colleges' reputations, or social activities. It is also possible that a student's enrollment decision is influenced by friends' enrollment decisions. Each of these examples is potentially unknown at the time of application and their realization affects enrollment choices. Hence, a larger number of applications increases the probability of favorable realizations of such uncertain outcomes. Consistent with more applications reducing uncertainty and unfavorable outcomes, Figure 1 shows the residual non-enrollees, who are students that are accepted somewhere but "Chose Not to Enroll." 19% of students

[1] U.S. Department of Education press release June 24, 2009.

[2] This 2004 statistic, calculated by the author using the Education Longitudinal Study of 2002, excludes students using early admissions or applying after graduating high school. It also excludes colleges that are open enrollment or for-profit.

applying to one college are accepted but still do not enroll and this number steadily decreases to under 4% for those sending six applications.

To fully understand this relation between enrollment and applications, I regress whether students enroll on their number of applications, controlling for student, parent, and high school characteristics. I find a strong positive correlation between the number of applications and enrollment. However, the coefficient on the number of applications may be endogenously biased in an ambiguous way. It may be that students who value attending college are both more likely to send out many applications and more likely to enroll. On the other hand, applicants who are less likely to be accepted by colleges due to reasons that are unobservable in the data and also not likely to enroll may send many applications to combat a high probability of rejection from each college.

To overcome the potential endogeneity, I use an instrumental variables approach to show that applying to additional colleges can substantially increase the probability of enrollment in a four-year college. I find that on average, one additional application can increase a student's probability of enrollment by 8.1%. Most of this effect is concentrated among students applying to very few colleges. I find that increasing the number of applications from one to two can increase a student's probability of enrollment by 40% (from 0.45 to 0.63). This result is partially due to the 84% decrease in the probability of being rejected from all schools applied to and partially due to the 51% decrease in the probability of choosing not to enroll, conditional on being accepted somewhere. Similarly, I find that increasing the number of applications from two to three can increase a student's probability of enrollment by 10% (from 0.72 to 0.795). There is no strong evidence that adding the fourth application (or more) increases a student's probability of enrollment, relative to the third application.

This paper links two other well researched topics: determinant of college applications and determinants of college enrollment. Several determinants of applications have been identified, such as affirmative action (Long 2004a), number of allotted free SAT score reports (Pallais 2013), joining the Common Application (Liu et al. 2007), tuition rates (McDuff 2010), and basic demographics and educational achievement (e.g. DesJardins et al. 1999). Likewise, identified determinants of college enrollment include: affirmative action (Bucks 2004; Long 2004b), financial aid (Fuller et al. 1982; Linsenmeier et al. 2002; Van der Klaauw 2002), basic demographics (Black and Sufi 2002), and family and legacy (Loury 2006; Hurwitz 2011). While these topics are separate from one another, they are intimately connected and often combined within the subtext of a structural model. Typically, researchers write down general equilibrium models to answer questions on topics like affirmative action (Arcidiacono 2005; Howell 2010), financial aid (Epple et al 2006; DesJardins et al. 2006), or market equilibria (Fu 2013). However, this is the first paper to examine and establish a direct link between the number of applications and enrollment rates.

The analysis unfolds in two parts. The first part looks at potential determinants of applications, including the Common Application. As of 2004, the Common Application is a consortium of about 250 colleges that accept a standardized application but still require individual application fees. I find that conditional on student, parent, and high school characteristics, living near relatively many Common Application colleges is associated with more applications. I also find that conditional on observables, men apply to fewer colleges than women, Asian and African American students apply to more colleges than their white counterparts, and high socioeconomic status (SES) students apply to more than low SES students. Also, high achieving students, as measured by grades, course selection, and standardized tests, apply to many colleges. Finally, the number of guidance counselors in a student's high school only has a marginal impact on the number of applications.

This second part is the main analysis on the effect of the number of applications on enrollment. I use a novel instrument: the adoption rate of the Common Application near a student's home. More formally the instrument is the ratio of the count of Common Application colleges within 300 miles of a student's home to the count of all colleges within 300 miles of a student's home. The intuition behind the instrument is that students prefer applying to colleges near their homes (Card 1993; Long 2004b) and the Common Application encourages more college applications (Liu et al. 2007). Hence, if students live near a Common Application college, they are likely to apply to that college and consequently, other Common Application colleges, thus increasing the number of applications.[3] Consistent with this intuition, the previous part of the paper shows that on average, students living near relatively many Common Application colleges and high adoption rate areas send more applications. The results indicate that sending more applications increases enrollment rates and this is robust to many specifications.

The policy implication of these results is an important contribution of this paper for two reasons. First, it provides policy makers with an additional tool to increase enrollment rates. Potential methods of implementation are discussed in the last section, in addition to comparisons to alternative applications schemes used in other countries. Second, the effect of applications is on a distinct and desirable segment of the population. There exists students at the extremes that are almost definitely going to attend college and almost definitely not going to attend college. The latter of the two will likely not send any applications and

[3] The validity of the instrument is discussed in detail in Section 4.1.

this research has little bearing on them because going from zero to some positive number of applications is a separate research question. On the other hand, going from one to two applications, or something similar, is a relatively unexplored idea. These students already expressed interest in attending college by engaging in the application process and foregoing any associated fixed costs.

The paper continues as follows; Section 2 describes the data and Section 3 explores some determinants of applications. Sections 4 and 5 are the main analyses (empirical strategy and results) on how applications affect enrollment. Finally, Sections 6 and 7 conclude with a policy discussion and some final remarks.

2 Data

The primary data source is the Education Longitudinal Study 2002 (ELS).[4] The dataset is a nationally representative sample of students. The data start in 2002 with sophomores in high school and follow the cohort through their transition into college. The data include information from students, parents, and high school administrators. The first follow-up of 2004 updates their high school career and college preparatory work while the second follow-up of 2006 is two years subsequent to high school. The 2006 follow-up provides detailed data on the college application process and the first year of college. For each student, it includes information on the number of applications, the result of each application (with some financial aid information), and enrollment decision.

The original 2002 survey included about 15,400 students. By the second follow-up of 2006, attrition reduced the sample to approximately 14,200 students. As this paper addresses the college application process, I exclude students who do not apply to college, students who only apply to open enrollment colleges or for-profit colleges, and those who do not apply during high school.[5] Also, I exclude several students because they are missing critical variables. Finally, I exclude students who apply using early applications.[6] The final dataset consists of 5,970 students.

[4] ELS is U.S. government restricted-use data that by law requires all observation counts to be rounded to the nearest 10.

[5] Open enrollment and for-profit colleges are identified in ELS.

[6] Early applications are not formally identified, so I eliminate those who apply to only one early decision (or early action) school and is accepted. Students may still avail themselves of early applications and either be rejected or pushed into the non-early application pool. However, in 2003, only 17.7% of all four-year colleges offered early decision. In these colleges, the mean percentage of all applications received through early decision was 7.6% (Admission Trends Survey, NACAC, 2004). Therefore, it is a relatively small issue and moving forward and I assume no students in the subsample utilize early decision.

Summary statistics on student characteristics are in Table 1. The SES quartiles shown in Table 1 are a weighted average of each parents' education, occupation (e.g. clerical, professional, laborer, etc.), and income. These quartiles are commonly used in educational studies performed by the U.S. Department of Education. Note the large fraction of students from the highest SES quartile.

There are also several data sources for detailed information on the colleges. First, information on each of the colleges a student applies to is drawn directly from Integrated Postsecondary Educational Database System (IPEDS).[7] These data provides information on location, tuitions, and average grant size of colleges. Also, data on early admissions were found from two independent websites[8] while data on the Common Application were provided directly from the organization.[9]

3 Determinants of Applications

This section details students' sets of applications and investigates potential determinants of the number of applications and the number of Common Applications. Understanding relations between applications and other variables provides avenues for potential policy, including college enrollment policy, and for future research. The section starts with summary statistics of the students' applications, characteristics of the colleges to which students apply, as well as enrollment rates. It then describes the influence of the Common Application on the number of applications as well as variables associated with the adoption of the Common Application in a student's region. It concludes with other determinants of the number of applications.

3.1 Summary Statistics

Table 2 presents summary statistics on students' applications. The average number of applications is 3.16. This number is calculated as the number of four-year, non-profit, and not open enrollment colleges to which a student applies. To get a better idea of the entire distribution of the number of applications, Figure 2 plots the density. The modal number of applications is two, as nearly 30% of the sample submits this number. Not far off are

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[7] ELS includes some data from IPEDS but I merge in additional IPEDS data directly both from IPEDS and from the Delta Project, which is a cleaned version of IPEDS.

[8] Early Decision: http://talk.collegeconfidential.com/college-search-selection/354075-list-colleges-early-action-early-decision-rolling-admissions.html

http://www.petersons.com

[9] Common Application: http://www.commonapp.org

the proportion of students that apply to one or three colleges. However, there are sharp decreases in proportions of students applying to each successive application set size. It is somewhat surprising that the graph is so left-skewed given the amount of attention the media and highly selective colleges put on increases in the number of applicants.[10]

Table 2 also shows the number of applications is not monotonic in SES quartiles. Unconditionally, the highest quartile applies to approximately one more college than other quartiles. From these applications, students are on average offered admission to 2.29 colleges. Approximately 77% of the students applied for some sort of aid, which may include discounts, grants, work-study, or even loans.

Table 2 also shows several details of the types of colleges to which students apply. On average, about 49% of students' applications are to public colleges. While many students apply to all public colleges or all private colleges, approximately 50% of students apply to some mixture of the two. Also, 31% of the students apply to a college that accept the Common Application.

The formal relation between the number of applications and enrollment rates is the subject of the coming sections but enrollment rate summary statistics are in the middle of Table 2. 75.3% of applicants enroll in one of the colleges to which they apply; thus, 24.7% do not enroll in any colleges to which they apply. This is for two reasons: (1) 11.2% of students are not accepted to any of the colleges to which they apply, and (2) of the remaining 88.8% of students who are accepted to at least one college, 15.2% choose not to enroll. Enrollment rates also substantially differ by SES. The most disadvantaged SES have a 58% enrollment rate and the most advantaged is 87%.

3.2 Common Application

3.2.1 Background

The Common Application is a single application for enrollment that is used by approximately 250 member colleges.[11] Membership is inclusive, and "open to colleges and universities that promote access by evaluating students using a holistic selection process." After an application is filled out once, it can be submitted to any of the member colleges. However, each college the Common Application is submitted to requires an application fee and sometimes requires a supplemental form or essay.[12] The Common Application reduces the burden of

[10] For one of many examples, see Arenson's 2008 *New York Times* article.

[11] A complete list of member schools can be found at: https://www.commonapp.org/CommonApp/Members.aspx

[12] Common Application schools often accept either the Common Application or their own application, with no stated preference. I cannot distinguish which type of application is used, just whether or not the

applying to college by making students fill out an application only once.

The Common Application became fully operational in 1976 with 83 members. Since 2000, the Common Application has loosened it membership requirements and consequently, there is a substantial range of colleges accepting the form, including public and private colleges and colleges of varying levels of selectivity, across many states in the U.S. The locations of the colleges are depicted in Figure 3. There is a clear concentration of Common Application colleges in northeast.

Despite the range of colleges accepting the Common Application, generally speaking, they are more selective colleges than those not accepting the Common Application.[13] For example, the average Common Application colleges' average enrollee's SAT score is 1212 compared to 1047 for colleges not accepting the Common Application. However, the lowest average SAT score from a Common Application college is 885. Also, there are only eight public colleges that accept the Common Application, whereas almost 40% of colleges are public.

3.2.2 As a Determinant

The Common Application has been shown to increase applications to colleges in aggregate (Liu *et al* 2007) but this subsection tests whether the Common Application increases applications of individual students. The Common Application is later used as an instrument, so showing the relation between the number of applications and location of Common Application colleges is critical. I use two measures of the Common Application: the count of Common Application colleges within 300 miles of a student's home and the college adoption rate of the Common Application within 300 miles of a student's home. Each is depicted in Figure 4. The top panel shows that relative to each county, there is a large concentration of nearbye Common Application colleges in the northeast.

Table 3 presents results of regressions of the number of applications on the two measures of the Common Application. The first column shows the relationship between the count of Common Application colleges within 300 miles of the student's home and total number of applications. There is a positive and significant estimate of 0.0173. This coefficient implies that one extra application is sent for approximately every 50 Common Application colleges near a student's home. This estimate reveals a small effect, but the average number of Common Application colleges within 300 miles is over 39 and there is significant variation

Common Application is available.

[13] Descriptive statistics on Common Application colleges and non-Common Application colleges are in Appendix 1.

across states.

Perhaps more meaningful is not the count of Common Application colleges, but rather, the adoption rate, expressed as follows:

$$\frac{\text{\# Common Application colleges within 300 miles of student's home}}{\text{\# colleges within 300 miles of student's home}}$$

The adoption rate may be more meaningful than the count of Common Applications college because holding the number of Common Application colleges constant, if there are many colleges near a student's home, then there is a low probability that any one college, including Common Application colleges, will receive an application. On the other hand, if there is a high adoption rate in the area, then it is more likely that the applications will go to a Common Application college. The bottom panel of Figure 4 graphs the adoption rate of the Common Application by county. Notice that relative to the top panel, there is more regional variation in adoption rates than the absolute number of Common Applications near a county. Also, the high concentration of Common Application colleges in New England and the Mid-Atlantic is also met with equally as many colleges who do not accept the Common Application.

The second column of Table 3 uses the adoption rate of the Common Application and shows a robust estimate of over 4. This means if the local adoption rate increases by about 0.25, then students send one more application. Again, this is relatively small in magnitude as the average adoption rate in the sample is about 0.20. But an analogous way to put the estimates in context is that if 10 more Common Application colleges are near a student's home or if the adoption rate increases by 0.05, then one out of five students will send an extra application. This type of variation, especially in adoption rates, is very common both within and across states.

If Common Application colleges induce more overall applications, as this result is consistent with, there is potential to use something similar to the Common Application for policy (and an instrument).

The second set of results uses the number of Common Applications as the dependent variable. Similar to the previous results, living near a greater absolute number of Common Application colleges and living near a great relative number of Common Application colleges increases the number of Common Applications sent by a student.

3.3 Other Determinants of Applications

Table 3 has several control variables that can be interpreted as determinants of applications. The results show that males apply to about 0.25 fewer colleges than females, though there are no differences in the number of Common Applications. This result is in-line with aggregate statistics that show females are more likely than males to enroll in and graduate from college.[14] On the other hand, *ceteris paribus*, Asian students apply to more colleges than their white counterparts and black students apply to almost one entire college more than whites: one of the larger predictors of the number of applications. Also, although the descriptive statistics show that unconditionally, the highest SES quartile applies to one more college than the lowest SES, that number is muted to approximately 0.35 after controlling for observables. This result is consistent with a larger literature that low-SES students are less likely to apply to and enroll in four-year colleges than their high-SES counterparts, even conditional on academic ability, sometimes referred to as "undermatching" (Bowen, Chingos, and McPherson 2009; Hoxby and Avery 2013; Smith, Pender and Howell 2013).

Student achievement, as measured by GPA, the number of AP courses taken, and SAT scores do have a positive impact on the number of applications. The standardized math and reading achievement scores do not predict applications over and above the GPA. Table 3 also shows that the number of guidance counselors is positive but relatively small in magnitude. One extra guidance counselor only increases the number of applications by 0.025.

4 Empirical Strategy

This section details the empirical strategy, which generally consists of two parts: OLS and instrumental variables. The goal of the analyses is to determine whether the number of college applications has an effect on a student's probability of enrollment. This gives rise to the basic OLS specification[15]:

$$enrolls_i = \alpha N_i + X_i\beta + \varepsilon_i$$

where the dependent variable $enrolls_i$ equals one if student i enrolls in any four-year college and equals zero otherwise. The independent variable of interest is N_i, the number of colleges to which student i has applied. X_i is a set of control variables that may affect student i's enrollment. Most specifications will include controls for SES quartile, sex, race, as well as some high school achievement variables (GPA, number of AP courses, standardized math and reading scores, SAT scores, and a dummy for whether he or she plays a sport). Some specifications will also control for characteristics of the high school (number of guidance counselors, students, and teachers, public or private, urbanicity, percentage of students with

[14] Females earned 57% of all bachelor's degrees in 2008-2009 (NCES, *Digest of Education Statistics* 2010).

[15] A linear probability model need not be used. All future result hold with a probit model.

free lunch, percentage of minorities, and number of colleges within 300 miles of the student's home), parents (education, native language, and marital status), and the region (number of colleges in the area and the quality of the colleges in the area as measured by SAT scores of enrollees). ε_i is a student-specific error term that is assumed to be independent and normally distributed. I run a sparse specification with no controls and specifications with more or all controls so as to determine the direction of any potential bias from unobservables.

To decompose any estimated effect, two other specifications are used. First, I create a variable equal to one if the student is rejected from all colleges to which he or she applied. Second, the original specification is used but only for the subsample of students that are accepted to at least one college. By doing so, we can better understand if applying to more colleges increases enrollment only because the students have been accepted somewhere or rather, if increasing the application count has alternative effects; such as more and better choice.

Finally, I test for heterogeneous SES effects and non-linear effects of the number of application.

In this analysis, the primary independent variable in this section is the number of applications. It should be noted that the number of colleges that offer admission could be used. These numbers are highly correlated as applying to more colleges provides more acceptance offers. However, applying to more colleges is amenable to policy prescription, whereas getting more acceptances is not. I use the number of applications throughout the paper even though results hold when using the number of acceptances.

4.1 Instrumental Variables

Beyond OLS, I use instrumental variable regressions to address the endogeneity of the number of college applications. It is possible that OLS is biased due to unobservables correlated with the number of college applications. That is, ε_i may be correlated with N_i. But the direction of the bias is ambiguous. For example, students who really want to attend college, for unobservable reasons, may be likely to apply to many colleges and enroll in any college. On the other hand, undesirable applicants, for unobservable reasons, may likely be rejected from many colleges and thus apply to many colleges. An undesirable applicant may be someone with few extracurricular activities or a procrastinator who wrote an application essay at the last minute. Both undesirable traits are unobservable to the econometrician, but known to the student when choosing how many applications to send.

The instrument is the previously defined adoption rate of the Common Application within 300 miles of a student's home. I exploit the variation in adoption rates, which is pictured in the bottom panel of Figure 4. For this instrument to be valid it must satisfy the relevance condition and exclusion restriction. It is relevant because there is substantial evidence that students apply (and enroll) to colleges near their home[16] and the Common Application lowers the non-financial cost of filling out an application, which *ceteris paribus*, unambiguously increases the number of applications. Liu *et al* (2007) find that colleges joining the Common Application receive between a 5.7% and 7% increase in applications and attribute it to the decrease in opportunity time cost of completing an application. I also see that conditional on using the Common Application, students send 2.25 Common Applications, in addition to a few more applications, summing to an average of 4.75 total applications, well above the unconditional mean number of applications. Also, I use 300 miles because that is approximately the mean distance of an application in the data (as shown towards the bottom of Table 2). A radius of 300 miles gives colleges that are within several hours of home for most students. The sensitivity of the distance is tested.

The exclusion restriction for the instrument relies on the exogeneity of students' homes relative to the adoption rate of Common Application colleges. Assuming students' locations relative to any college, not just Common Application colleges, is exogenous is a fairly naive assumption. However, the only observable pattern on location of colleges adopting the Common Application, as exhibited in Figure 3, is the popularity in the eastern half of the country. In 2004, Common Application colleges are located in 38 different states. MA, PA, and NY have the largest number of Common Application colleges and CA and OH are not far off, but the remaining colleges are well dispersed. Sensitivity to the inclusion of these major states is tested as well as New England and the Mid-Atlantic states.

The dispersion of Common Application colleges implies that the adoption rate is likely to satisfy the exclusion restriction. One potential violation of the restriction is if likely college enrollees live in high adoption rate areas. This argument is difficult to rule out, but given the fairly large radius, the variation in adoption rates does not rely on those who live next to these college areas, but for those who are within some driving distance and are likely to be aware of the Common Application college's existence. Also, as the third panel of Table 3 indicates, the adoption rate is not strongly correlated with SES quartiles whereas college attendance is strongly correlated with SES quartiles.

Another potential violation of the exclusion restriction is if the adoption of the Common Application is correlated with other policies that influence enrollment rates. Liu *et al* (2007) find that colleges receive more applications a few years after the adoption of the Common

[16] In this sample, all else equal, students enroll in schools closer to home. See Card (1993) and Long (2004a) for more examples.

Application because new colleges join and increase the overall application pool. Other colleges joining the Common Application, often competing or distant colleges, has little to do with the enrollment strategy of the initial college. Moreover, increasing enrollment rates is often an initiative of a state and hence, public colleges, of which there are relatively few who adopt the Common Application.

One final concern with the exclusion restriction is that high adoption area are associated with college attendance for other reasons. To mitigate this concern I include two controls. First, I control for the total number of colleges within the 300 miles radius because living near any college is a known predictor of college attendance (Card 1993). Second, I control for the quality of the colleges within the 300 miles radius as measured by the average SAT scores of enrollees in those colleges. This means that the instrument relies on the effect of the adoption rate on applications over and above students living near high or low quality colleges.

Moving forward, I only present results with the described and preferred instrument. However, I test several related instruments and results do not substantially differ from one another. First, I test the number of Common application colleges within 300 miles of a student's home as the instrument, conditional on total number of colleges within the same radius. This relies on the absolute number of Common Application colleges, not the relative number. I also use the undergraduate enrollment of the Common Application colleges divided by the enrollment of all colleges within 300 miles of a student's home. This is a weighted by enrollment instrument. Similarly, I just use the enrollment of Common Application colleges within the radius as the instrument, conditional on the enrollment of all colleges within the radius.

5 Results

5.1 OLS

Results for the main OLS specification are in Table 4. The first specification's dependent variable is an indicator equal to one if the student enrolls in any of the colleges to which she applied. The first column has no control variables and has a coefficient of 0.064. This implies that one additional application is associated with a 6.4 percentage point increase in the probability of enrollment. The second column controls but suppresses most coefficients for the aforementioned student characteristics and the third column includes additional controls for characteristics of the high school and parents. Both specifications get a statistically significant coefficient on the number of applications over 0.03. This implies that inclusion of one extra college application is associated with more than a 3 percentage point increase in enrollment. The inclusion of control variables decreases the magnitude of the coefficient relative to the first specification, but the full set of controls does not statistically differ from the subset of controls.

The next dependent variable is an indicator for whether a student is rejected from all colleges. Using the same three specifications as before, results show that one additional college application is associated with a 2.4 percentage point decrease in the probability of being rejected everywhere. The next panel's dependent variable is an indicator equal to one if a student chooses to enroll, conditional on being accepted to at least one college. Using only the subsample of students accepted to at least one college, Table 4 shows an approximately 2 percentage point increase in the probability of choosing to enroll when applying to an additional college.

There are several other coefficient estimates of note in Table 4. For example, black students are marginally more likely to enroll than their white counterparts, conditional on all the other variables, but Hispanic students are less likely. Interestingly, SES has no relationship with enrollment, but this is conditional on number of applications. This result is in the spirit of Dale and Krueger (2002) and Hoxby and Turner (2013) who find that that after conditioning on an application set, students tend to have similar outcomes. In addition, having a parent who has attended college appears to have a positive association with enrollment, as does student aptitude.

5.2 Instrumental Variables

The two-stage least squares results are presented in Table 5.[17] The first set of results are directionally similar to the OLS results but greater in magnitude. Using the full set of controls, one additional application leads to about a 6.1 percentage point increase in the probability of enrollment.

The next two panels disentangles this result and shows that it is a mixture of being more likely to be accepted somewhere and simply being more likely to choose to enroll. All of the specifications are statistically different than zero and directionally intuitive. That is, applying to more colleges reduces the probability of being rejected everywhere and increases the probability of choosing to enroll, conditional on being accepted.

Overall, the IV estimates are larger than the OLS results, which suggests that endogeneity may be a concern. In light of this concern, I test for endogeneity with a Hausman Test and then I appeal to a previous result regarding endogeneity. These checks are useful

[17] The first-stage results are in Table 3.

because if endogeneity is not a big concern, I can test more flexible specifications using OLS, which is difficult in an IV setting with only one instrument.

The Hausman Test tests the model choice in the linear setting: OLS versus IV. As the bottom of Table 5 shows, the chi-squared p-values are 0.168, 0.759, and 0.115 for the three dependent variables "Enrolls in College," "Rejected from all Colleges," and "Enrolls Given Accepted," respectively. These tests imply an inability to reject that the potentially endogenous variable (number of applications) is exogenous.

The next test for endogeneity comes from the right most column of Table 4. This specification uses the subsample of students that are accepted somewhere and includes a control for the number of acceptances. After controlling for observables, the number of applications predicts a student's probability of enrollment only through the student's acceptances and any unobservable biases. Results show a strong positive coefficient on the number of acceptances but a small and insignificant coefficient on the number of applications. In other words, the biases from selection of the number of applications on unobservables is small.

The control variables throughout the table provide some context. As with the OLS results, having high standardized test scores are positively related to enrollment. In fact, the math standardized test score is of a similar magnitude to the coefficient on number of applications implying that a one standard deviation in math ability has a similar effect to an additional application. This comparison indicates that the effect of the number of applications is relatively large. In fact, it is larger than the relationship between SES and enrollment, despite the fact that a growing body of research finds that, due to a lack of information and support, SES is a determinant of enrollment (Hoxby and Avery 2013; Dillon and Smith 2013).

5.3 Robustness

Table 6 tests the robustness of the OLS and IV results in two general ways. First, I exclude potentially troublesome states. It is possible that results are driven by certain states where students are very likely to live near Common Application colleges and moreover, the states are highly educated. In other words, there may be a violation of the exclusion restriction. Massachusetts, New York, and Pennsylvania potentially fall under this category. These are the states that have the greatest number of Common Application colleges, each over 20. California and Ohio also have a fair amount of Common Application colleges and are relatively educated states, hence, they are also potential states to exclude. As Figure 4 shows, there is a large concentration of Common Application colleges in New England and

Mid-Atlantic states, so I also exclude them in a separate regression.

The second robustness check is on the choice of a 300 miles radius around the students' homes. Though 300 miles is based on the average student application, the average could be pushed upward or downward by outliers. Hence, I also test results using 200 miles and 400 miles for the instrument.[18]

As Table 6 shows, results are not too sensitive to the subset of states or the distance of the instrument in two respects. First, within OLS (top panel) or IV (bottom panel), each specification's coefficient on the number of applications is similar in magnitude to the baseline specification with all states and 300 miles radius. All OLS results are strongly significant and almost every IV result is significant.

Second, within a specification, the OLS and IV coefficients are similar to one another.

5.4 Alternative Specifications

This subsection runs three tests using alternative and flexible specifications. The first test looks for heterogeneity of the effect of the number of applications by SES quartile. The second and third tests look for non-linearities in the effect of the number of applications using both OLS and IV.

Table 7 presents similar regressions but tests for differential effects by SES quartile. Each regression only uses the subsample of students in their respective SES quartile (e.g. SES1 means SES quartile 1). With the first dependent variable, "Enrolls in College," the coefficients on the number of application are approximately 0.18 for the SES1 and SES2 subsamples. The estimate for the SES1 subsample is marginally significant and the estimate for the SES2 subsample is marginally insignificant. The marginal significance is in large part due to a sharp increase in standard errors. Despite the imprecision, these estimate imply an extra application increases the probability of enrollment by 18 percentage points, which is much larger than the estimates for the SES3 and SES4 subsamples.

The second set of tests in Table 8 estimate several non-linear OLS and IV models to show a parsimonious non-linear IV specification may convince them that the effect is strongest for those applying to very few colleges. Due to a single instrument, I can only have one endogenous regressor. Thus, I use two different binary endogenous regressors: "One Application" and "One or Two Applications."

For both the OLS and IV, the first column shows a strongly negative coefficient on students applying to one college, relative to those applying to more than one college. Con-

[18] The instrument loses power as the radius gets smaller and so I do not show those results.

sistent with previous results, the OLS result is downward biased. The IV result implies that students applying to one college are 48 percentage points less likely to enroll than students applying to more than one college. The second column shows that when the variable of interest is "One or Two Applications," the coefficient decreases in magnitude. This result is in part because going from one to two applications may have an effect on enrollment rates (but this is not estimated) and in part because going from two to more than two applications has a smaller effect than going from one to more than one application. Combined, these results provide more evidence that the effect of more applications on enrollment is strong for those applying to very few colleges. The second and third panels are consistent with this story.

Table 9 presents the results of the most flexible non-linear tests of the relation between the number of applications and enrollment rates. It includes dummy variables for students sending out each number of application (e.g. one, two, three,...) and compares their enrollment outcomes to students sending more than five applications. Due to the single instrument, I can only use OLS. As the table shows, applying to one college greatly reduces the probability of enrollment (relative to applying to more than five colleges) because there is both a large chance of being rejected and because students frequently chooses not to enroll. There is also a statistical difference in the probability of enrolling between applying to one versus two colleges as well as two versus three colleges.[19] There is no statistical difference between the third and fourth application and the magnitude of the effect disappears entirely with more applications. These specifications are compelling evidence that the relation between applications and enrollment is non-linear.

Given that the true model appears to be non-linear, it is worth re-visiting the endogeneity issue and the validity of these flexible estimates. To test for endogeneity in Table 9's specification, I use the Lochner and Moretti (LM) Wald Test, which is similar in spirit to a Hausman Test but intended for non-linear models when there is only one instrument.[20] It tests whether the OLS estimates in the non-linear model are endogenously biased. As Table 5 shows, the null hypotheses that the OLS estimates are exogenous cannot be rejected with estimated p-values of 0.314, 0.733, and 0.151 for each of the three dependent variables. Moreover, in all the previous IV results, such as Tables 5, 6, and 8, there is substantial evidence that the OLS estimates are biased downward. Hence, this flexible specification likely provides conservative estimates of the causal effect of applications.

[19] Used a Wald test.

[20] The basic idea is that a Hausman test is not appropriate if the true model is non-linear. The test allows for a non-linear OLS specification when there is only a single instrument. See Lochner and Moretti (2011) for details.

5.5 Interpretation of Results

Overall, estimates show that applying to an additional college does have an effect on the probability of enrolling in college, but mostly for those applying to very few colleges. Moreover, the magnitude of the estimates is economically meaningful. First consider the linear specifications. Instrumental variables estimates show that an extra application increases the probability of enrollment by about 6.1 percentage point. Given the enrollment rate of 0.75, this is a 8.1% increase in the probability of enrollment. However, using the unconditional enrollment rate of 0.75 is somewhat conservative since, according to Tables 7, 8, and 9 the effect is likely strongest for those low SES students and those applying to very few colleges, each of whom have low enrollment rates.

To get a better sense of the magnitude of the effect, consider the non-linear OLS specification in Table 9.[21] The unconditional enrollment rates of students applying to one, two, and three colleges is 0.45, 0.72, and 0.83, respectively. This implies two things. First, with a base enrollment rate of 0.45 for one application students, the second application increases the probability of enrollment by 40% (0.18 percentage points). This is partially due to the 84% decrease in the probability of being rejected from all schools applied to (from 0.23 to 0.04) and partially due to the 51% decrease in the probability of choosing not to enroll, conditional on being accepted somewhere (from 0.15 to 0.07). Similarly, increasing the number of applications from two to three can increase a student's probability of enrollment by 10%.

Second, the enrollment rate gaps between one and two college application senders and two and three college application senders is 0.27 and 0.11, respectively. The first column of Table 9 states that 0.18 out of 0.27 (or 67%) and 0.075 out of 0.11 (or 68%) of the enrollment gaps are because of the difference in the number of applications. Moreover, 0.08 out of 0.27 (30%) and 0.049 out of 0.11 (or 45%) is explained by an extra application but not explained by the reduction in probability of not being accepted anywhere. This is a substantial amount of the enrollment gap.

What remains to be answered is how can we explain this result? A portion of this answer is trivial: simple algebra can show how the probability of being rejected everywhere decreases with the number of applications. However, conditional on being accepted somewhere, why does applying to more colleges affect the enrollment probability? There are several potential reasons. One explanation lies in the search model literature. The application to colleges is analogous to many search models in that students face uncertainty and would like to

[21] Given evidence that the OLS estimates cannot be rejected over the IV estimates and since they are likely downward biased, this specification is easiest to interpret and conservative.

reduce the probability of a bad outcome by applying to more colleges, but this comes at the cost of application. In this paper, the uncertainty comes from the revelation of the terms of being admitted to the college such as offers of financial aid and work-study or placement into a good dormitory, etc. These pieces of information are all revealed after the application stage but have a direct impact on utility and probability of enrollment. So to maximize the probability of a good outcome, students have an incentive to apply to more colleges. However, there is a disutility of applying to colleges and therein lies the trade-off found in many search models: more search leads to better outcomes but more search is costly. Therefore, those that apply to more college, whatever the reason, will have better outcomes, conditional on being accepted somewhere, and be more likely to enroll. And students may apply to many colleges for a number of reasons including: high benefits or returns to college, low costs of application, relatively risk averse, or low probabilities of acceptance.

There exists financial aid evidence consistent with this theory. Notice that in Table 2, the mean number of colleges providing financial aid is close to one whereas the mean number of colleges offering acceptance is 2.3. More accurately, of students accepted to at least two colleges who applied for financial aid, just under 50% of students receive aid at zero colleges or all colleges. This implies that many students receive aid at some colleges but not others. Given that different colleges provide differing aid, there is a theoretical justification for applying to more colleges.

Another potential explanation is a fundamental difference in how students make decisions. If a student is only admitted to one college, as many are, the choice is whether or not to attend college. If students are admitted to several colleges, the choice is not only whether or not to attend college, but where to attend college. Perhaps this extra decision changes a student's knowledge and interest in a particular college. Or perhaps being accepted to multiple colleges gives students bargaining power, which results in better admission offers and increased enrollment rates.

6 Policy Discussion

Increasing applications can serve as another policy tool to increase enrollment, and it can be especially effective on the students that already express interest in college: those who engage in the application process but only apply to a few colleges. The potential policy instrument helps contributes to the growing literature on undermatch, whereby a student enrolls in a college with average academic credentials well below that of his or her own credentials (e.g.

Bowen, Chingos, and McPherson 2009). Many students, including low-SES students, have the academic record to enroll and succeed in four-year colleges, but do not apply or enroll to those colleges, but rather, enroll in two-year colleges or not at all (Hoxby and Avery 2013; Smith, Pender and Howell 2013). As this paper shows, once I condition on the number of applications, there are fewer differences by SES than the literature would suggest and therefore, a policy that gets students to apply to more colleges may increase four-year college enrollment rates and reduce undermatch rates.

If increasing applications is a tool policy makers want to use to increase enrollment or reduce undermatch rates, there are two things to address: How do we accomplish this? And what are the consequences? For example, one relatively simple way to get more applications is to provide the information somewhere in the pipeline. That is, getting students to apply to more colleges may involve informing school counselors, parents, college counselors, or the students of the benefits of numerous applications. Basically, students may only need a small "nudge"[22] to apply to more colleges. Such policies have been attempted. For example, Avery (2009) finds that free college counseling to low-income students did not increase the total number of applications to college, but did increase the number of applications to more competitive colleges. Also, Hoxby and Turner (2013) show that high-ability, low-income students who receive simple informative mailings about colleges and their net costs changes the quality and quantity of the colleges to which the students apply.

On the other hand, getting more applications can be a large scale policy. For example, more Common Application colleges, or something similar, can achieve a greater number of applications. Perhaps there could be a common application for specific students, such as low-SES students, not specific colleges.

There is even potential for a greater overhaul of the application process that mimics that of other countries. Numerous countries only require a single application for a large set of colleges or even all colleges within the borders. In the United Kingdom, there is a single clearing house that all students must apply through. Students can list up to five programs of study, either within the same college or in different colleges, and each of those "courses" consider the student's application. There are both fewer students and colleges in the U.K. than in the U.S. but the limit on number of applications reduces the likelihood of applications from students unlikely to matriculate. Ireland has a Central Applications Office that ranks students based on a test score and offers students admission if there is still capacity after all those students with higher ranks have decided whether to attend a student's preferred institution. Similar sorting of students and simplified admissions occur in Australia, Brazil,

[22] See Thaler and Sunstein (2008).

China, and India, where either regional or national organizations consider only qualifying tests or a combination of grades and tests to rank students. While most German universities have independent admissions criteria, there is a central application system for students interested in medical fields such as biology, medicine, pharmacy, psychology, animal health and dentistry (Braun and Dwenger, 2008). Having U.S. students apply to specific subjects would not be popular among many institutions, but there are specialty colleges that may be amenable to such a process. Internationally, there is a range of centralized application processes and while something like this may seem difficult to accomplish with so many institutions and different types of institutions in the U.S., several states, including California, have moved in that direction by implementing a centralized application system for colleges within the state system.

An alternative method is to incentivize students. This could be through subsidization of applications. Low income students already have application fees waived, but they could be paid for each application (up to a certain point). In a similar vein, the application process can be simplified. Research shows that filling out financial aid forms and applications prevents students from even engaging in the processes (Bettinger et al. 2012). Any simplification of the application process or financial incentive effectively reduces the costs of applications. This type of policy is already underway in North Carolina with College Application Week in which students, especially first-generation students and those that may not already apply, receive help with their applications. Several other states have started something similar and a national College Application Week is in the works.[23]

In regards to the second question, the consequences of more applications can become negative if a policy encourages too many applications. Too many applications may cause colleges to change admissions criteria and increase screening costs. Therefore, any policy should be implemented with care and target the intended audience: students that are only applying to one or two colleges and have a low probability of enrollment.

7 Concluding Remarks

This paper looks at effects of the number of applications on college enrollment rates. I show evidence that getting students to apply to more colleges can increase their probabilities of enrollment, especially for those applying to only one or two colleges. Specifically, going from one to two applications and two to three applications increases students' probabilities of enrollment by 40% and 10%, respectively. This provides another potential policy tool to

[23] http://xapceo.blogspot.com/2011/05/why-national-college-application-week.html

increase enrollment: something policy makers often try to achieve.

Future work should more formally investigate general equilibrium effects of students applying to more colleges. To properly do so, a structural model of the entire market, both the student and the college, needs to be developed. There are several versions of this model in existence and they could probably begin to address the question, however few of them observe and utilize the entire application set (other than Howell 2010).

There is still an open question as to why students apply to so few colleges, especially given these results. It could be because of high costs of application, low perceived benefits of college, or relatively good outside options. But these explanations are all somewhat unsatisfying. This paper is not well suited to investigate further, but it warrants more research.

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Table 1: Summary Statistics - Student Characteristics
rounded num obs = 5,970

Variable	Mean	Std. Dev.	Min	Max
Male	0.454	0.498	0	1
Asian	0.118	0.322	0	1
Black	0.124	0.330	0	1
Hispanic	0.099	0.298	0	1
Other race	0.053	0.224	0	1
GPA	3.105	0.732	0.39	4.59
AP courses	0.180	0.419	0	3
Standardized math score*	0.016	0.730	-2.84	2.59
Standardized reading score*	-0.097	0.730	-2.46	1.85
Plays sport	0.676	0.468	0	1
At least one parent college graduate	0.555	0.497	0	1
Parents native language is english	0.753	0.431	0	1
Student SAT**	1049	201	420	1600
Socioeconomic Status				
1st quartile	0.135	0.342	0	1
2nd quartile	0.178	0.382	0	1
3rd quartile	0.261	0.439	0	1
4th quartile	0.426	0.495	0	1
Location of Student				
Urban	0.370	0.483	0	1
Suburban	0.483	0.500	0	1
Rural	0.147	0.354	0	1
High School Type				
Public	0.676	0.468	0	1
Catholic	0.203	0.402	0	1
Other private	0.121	0.326	0	1

*Standardized test scores, computed as achievement relative to population. Provided by ELS.

**Only 4,390 observations for student SAT as some did not take the test.

Table 2: Summary Statistics - Applications

Variable	Mean	Std. Dev.	Min	Max
Student Level (5,970 rounded obs)				
Number of applications	3.16	2.05	1	18
SES quartile 1 (lowest)	2.67	1.86	1	15
SES quartile 2	2.62	1.67	1	13
SES quartile 3	2.89	1.77	1	15
SES quartile 4 (highest)	3.70	2.28	1	18
Fraction of applicants enrolling in college	0.75	0.43	0	1
SES quartile 1 (lowest)	0.58	0.49	0	1
SES quartile 2	0.63	0.48	0	1
SES quartile 3	0.74	0.44	0	1
SES quartile 4 (highest)	0.87	0.34	0	1
Number of colleges offered admission	2.29	1.70	0	14
Fraction of applicants accepted nowhere	0.11	0.31	0	1
Fraction of applicants choosing not to enroll*	0.15	0.36	0	1
Avg verb SAT, colleges applied	551	52	375	729
Avg math SAT, colleges applied	561	55	370	750
Applied for aid	0.77	0.42	0	1
Number of colleges giving aid	0.98	1.39	0	13
Fraction of public college applications	0.49	0.40	0	1
Used Common Application	0.31	0.46	0	1
Count of Common Applications used**	2.25	1.73	1	14
Count of Common Applications w/i 300 km	39.31	39.06	0	126
Student-College Level (18,850 rounded obs)				
Tuition in 1000s	14.47	10.36	0	42.14
Tuition (net of grants) in 1000s***	10.64	10.29	0	42.14
In-state resident	0.63	0.48	0	1
Distance to college (in 100s of miles)	2.98	5.41	0	50.62
Offered admission	0.72	0.45	0	1
Received work-study	0.15	0.35	0	1

Note: rounded number of obs for SES1, SES2, SES3, and SES4, respectively, are 810, 1060, 1560, and 2540.

*Conditional on being accepted to at least one school (5300 obs)

**Conditional on applying to at least one common application school (1850 obs).

***Actual amount of grants is not observed. This is an estimate based on the average size of grant at a school and the estimated probability of receiving a grant.

Table 3: Determinants of Number of Applications, Common Application, and Common Application Adoption
OLS

Variable	*Dependent Variable:* Number of Applications		Number of Common Applications		Adoption Rate of Common Application w/in 300 miles
Count of Common Application colleges within 300 miles	0.0173***	--	0.0101***	--	--
	(0.0017)	--	(0.0009)	--	--
Adoption Rate of Common Application colleges within 300 miles	--	4.2560***	--	2.4356***	--
	--	(0.4226)	--	(0.2558)	--
Number of applications	--	--	0.4018***	0.4038***	--
	--	--	(0.0139)	(0.0139)	--
Male	-0.2756***	-0.2622***	-0.0158	-0.0075	-0.0026*
	(0.0497)	(0.0497)	(0.0264)	(0.0265)	(0.0015)
Asian	0.5043***	0.5279***	-0.1544***	-0.1412**	0.0121***
	(0.1061)	(0.1058)	(0.0572)	(0.0574)	(0.0039)
Black	0.7882***	0.7731***	-0.0171	-0.0275	0.0002
	(0.0834)	(0.0832)	(0.0441)	(0.0442)	(0.0040)
Hispanic	0.1219	0.1471	-0.0062	0.0088	0.0162***
	(0.0912)	(0.0912)	(0.0493)	(0.0496)	(0.0048)
Other race	0.2971***	0.3410***	0.0071	0.0320	0.0000
	(0.1071)	(0.1057)	(0.0590)	(0.0599)	(0.0033)
SES quartile 2	-0.0595	-0.0537	-0.0067	-0.0031	0.0010
	(0.0768)	(0.0769)	(0.0374)	(0.0373)	(0.0025)
SES quartile 3	-0.0522	-0.0358	-0.0518	-0.0421	0.0027
	(0.0803)	(0.0802)	(0.0408)	(0.0408)	(0.0024)
SES quartile 4	0.3591***	0.3586***	0.0694	0.0686	0.0056*
	(0.0997)	(0.0996)	(0.0510)	(0.0510)	(0.0030)
GPA	0.3183***	0.3358***	0.0280	0.0374	-0.0034***
	(0.0428)	(0.0430)	(0.0227)	(0.0229)	(0.0013)
AP courses	0.3935***	0.3819***	0.2394***	0.2319***	0.0040**
	(0.0778)	(0.0777)	(0.0463)	(0.0465)	(0.0019)
Standardized math score	-0.0526	-0.0502	-0.0410	-0.0394	0.0015
	(0.0558)	(0.0557)	(0.0295)	(0.0295)	(0.0015)
Standardized reading score	-0.0732	-0.0799	0.0618**	0.0581**	0.0012
	(0.0498)	(0.0500)	(0.0270)	(0.0270)	(0.0014)
SAT (in 100s)	0.2620***	0.2571***	0.0930***	0.0896***	-0.0007
	(0.0229)	(0.0229)	(0.0120)	(0.0120)	(0.0006)
Plays sport	0.2671***	0.2716***	-0.0399	-0.0379	-0.0023
	(0.0510)	(0.0511)	(0.0270)	(0.0270)	(0.0014)
Number of guidance counselors in high school	0.0254*	0.0325**	-0.0004	0.0036	-0.0009*
	(0.0146)	(0.0146)	(0.0079)	(0.0079)	(0.0005)
High school student enrollment	0.0473	0.0601	-0.1033***	-0.0958***	0.0055**
	(0.0562)	(0.0565)	(0.0311)	(0.0311)	(0.0023)
At least on parent college graduate	0.1091	0.1127*	-0.0158	-0.0139	0.0006
	(0.0668)	(0.0668)	(0.0341)	(0.0342)	(0.0020)
Parent's native language is English	-0.0040	-0.0042	0.0793**	0.0790**	-0.0049***
	(0.0685)	(0.0686)	(0.0372)	(0.0373)	(0.0019)
Count of all colleges within 300 miles	-0.0040***	-0.0005	-0.0023***	-0.0002	0.0004***
	(0.0005)	(0.0003)	(0.0003)	(0.0002)	(0.0000)
Average SAT of all colleges within 300 km	0.0026**	0.0007	0.0004	-0.0007	0.0013***
	(0.0011)	(0.0008)	(0.0004)	(0.0005)	(0.0004)
Observations	5970	5970	5970	5970	5970
R-Squared	0.245	0.243	0.521	0.519	0.616
F-Statistic	39.21	39.07	51.25	50.69	540.55

Note: Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. Also controls for whether student took the SAT, family composition, whether high school is public, high school urbanicity and percent free lunch and percent minority, and the student-teacher ratio.

Table 4: Effect of Number of Applications on College Enrollment
OLS

	Binary Dependent Variable:									
Variable	*Enrolls in College*			*Rejected From All Colleges*			*Enrolls Given Accepted*			
Number of applications	0.0642***	0.0349***	0.0324***	-0.0413***	-0.0246***	-0.0241***	0.0323***	0.0189***	0.0167***	0.0014
	(0.0024)	(0.0023)	(0.0024)	(0.0019)	(0.0016)	(0.0017)	(0.0020)	(0.0020)	(0.0021)	(0.0035)
Male	--	0.0125	0.0105	--	-0.0092	-0.0086	--	0.0096	0.0082	0.0090
	--	(0.0102)	(0.0103)	--	(0.0079)	(0.0079)	--	(0.0099)	(0.0100)	(0.0100)
Asian	--	-0.0263*	-0.0027	--	0.0228*	-0.0015	--	-0.0080	0.0021	0.0055
	--	(0.0159)	(0.0194)	--	(0.0121)	(0.0152)	--	(0.0149)	(0.0185)	(0.0185)
Black	--	0.0217	0.0346*	--	-0.0131	-0.0264*	--	0.0144	0.0208	0.0200
	--	(0.0177)	(0.0191)	--	(0.0151)	(0.0158)	--	(0.0181)	(0.0197)	(0.0196)
Hispanic	--	-0.0635***	-0.0477**	--	0.0129	-0.0073	--	-0.0648***	-0.0626***	-0.0649***
	--	(0.0193)	(0.0210)	--	(0.0149)	(0.0160)	--	(0.0203)	(0.0217)	(0.0217)
Other race	--	-0.0188	-0.0055	--	0.0117	-0.0002	--	-0.0093	-0.0026	-0.0026
	--	(0.0228)	(0.0232)	--	(0.0176)	(0.0181)	--	(0.0225)	(0.0229)	(0.0228)
SES quartile 2	--	0.0003	-0.0158	--	-0.0261	-0.0185	--	-0.0139	-0.0276	-0.0272
	--	(0.0196)	(0.0201)	--	(0.0170)	(0.0174)	--	(0.0213)	(0.0218)	(0.0217)
SES quartile 3	--	0.0547***	0.0259	--	-0.0636***	-0.0518***	--	0.0230	-0.0013	-0.0003
	--	(0.0183)	(0.0202)	--	(0.0153)	(0.0170)	--	(0.0194)	(0.0215)	(0.0215)
SES quartile 4	--	0.0844***	0.0380	--	-0.0613***	-0.0436**	--	0.0539***	0.0154	0.0163
	--	(0.0175)	(0.0234)	--	(0.0144)	(0.0188)	--	(0.0183)	(0.0244)	(0.0243)
GPA	--	0.1466***	0.1558***	--	-0.1024***	-0.1055***	--	0.0918***	0.1011***	0.0941***
	--	(0.0097)	(0.0099)	--	(0.0081)	(0.0083)	--	(0.0102)	(0.0105)	(0.0106)
AP courses	--	-0.0543***	-0.0513***	--	0.0515***	0.0480***	--	-0.0272***	-0.0265***	-0.0250**
	--	(0.0108)	(0.0110)	--	(0.0063)	(0.0065)	--	(0.0100)	(0.0102)	(0.0102)
Standardized math score	--	0.0491***	0.0495***	--	-0.0394***	-0.0399***	--	0.0315***	0.0314***	0.0314***
	--	(0.0110)	(0.0111)	--	(0.0086)	(0.0087)	--	(0.0111)	(0.0111)	(0.0111)
Standardized reading score	--	0.0252**	0.0203**	--	-0.0214***	-0.0191**	--	0.0167*	0.0131	0.0131
	--	(0.0102)	(0.0103)	--	(0.0078)	(0.0079)	--	(0.0100)	(0.0101)	(0.0101)
SAT (in 100s)	--	0.0177***	0.0165***	--	-0.0029	-0.0021	--	0.0098**	0.0085*	0.0083*
	--	(0.0041)	(0.0041)	--	(0.0035)	(0.0035)	--	(0.0044)	(0.0044)	(0.0044)
Plays sport	--	0.0356***	0.0322***	--	-0.0175**	-0.0150*	--	0.0256**	0.0236**	0.0216**
	--	(0.0105)	(0.0106)	--	(0.0082)	(0.0082)	--	(0.0104)	(0.0105)	(0.0104)
At least on parent college graduate	--	--	0.0269*	--	--	-0.0102	--	--	0.0195	0.0204
	--	--	(0.0151)	--	--	(0.0113)	--	--	(0.0151)	(0.0151)
Parent's native language is English	--	--	0.0085	--	--	-0.0078	--	--	0.0016	-0.0009
	--	--	(0.0148)	--	--	(0.0118)	--	--	(0.0148)	(0.0148)
Number of acceptances	--	--	--	--	--	--	--	--	--	0.0247***
	--	--	--	--	--	--	--	--	--	(0.0044)
-High school and region characteristics controls:	No	No	Yes	No	No	Yes	No	No	Yes	Yes
Observations	5970	5970	5970	5970	5970	5970	5300	5300	5300	5300
R-Squared	0.094	0.276	0.285	0.073	0.219	0.224	0.035	0.129	0.139	0.142

Note: Results are from linear probability model. Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. High school characteristics include number of guidance counselors, number of students, public or private, urbanicity, percent free lunch, percent minority, and student-teacher ratio. Region characteristics include the number of colleges within 300 miles of the students home and the average SAT score of those colleges.

Table 5: Effect of Number of Applications on College Enrollment
Instrumental Variables Estimate
Instrument: Adoption Rate of Common Application Colleges within 300 miles of Student's Home

	Binary Dependent Variable:								
Variable	*Enrolls in College*			*Rejected From All Colleges*			*Enrolls Given Accepted*		
Number of applications	0.0518***	0.0707***	0.0613***	-0.0247**	-0.0383***	-0.0290*	0.0332**	0.0469***	0.0466***
	(0.0166)	(0.0147)	(0.0199)	(0.0124)	(0.0112)	(0.0150)	(0.0143)	(0.0132)	(0.0178)
Male	--	0.0223**	0.0181	--	-0.0129	-0.0098	--	0.0175*	0.0163
	--	(0.0111)	(0.0117)	--	(0.0085)	(0.0089)	--	(0.0106)	(0.0112)
Asian	--	-0.0556***	-0.0176	--	0.0340**	0.0005	--	-0.0330*	-0.0148
	--	(0.0199)	(0.0228)	--	(0.0150)	(0.0172)	--	(0.0188)	(0.0216)
Black	--	-0.0101	0.0085	--	-0.0009	-0.0210	--	-0.0115	-0.0053
	--	(0.0220)	(0.0243)	--	(0.0180)	(0.0190)	--	(0.0219)	(0.0239)
Hispanic	--	-0.0795***	-0.0524**	--	0.0191	-0.0069	--	-0.0789***	-0.0697***
	--	(0.0203)	(0.0215)	--	(0.0156)	(0.0163)	--	(0.0212)	(0.0223)
Other race	--	-0.0335	-0.0150	--	0.0174	0.0013	--	-0.0223	-0.0145
	--	(0.0237)	(0.0243)	--	(0.0178)	(0.0183)	--	(0.0236)	(0.0244)
SES quartile 2	--	0.0010	-0.0149	--	-0.0264	-0.0185	--	-0.0113	-0.0250
	--	(0.0196)	(0.0200)	--	(0.0169)	(0.0173)	--	(0.0214)	(0.0218)
SES quartile 3	--	0.0513***	0.0261	--	-0.0623***	-0.0517***	--	0.0227	0.0014
	--	(0.0183)	(0.0201)	--	(0.0153)	(0.0169)	--	(0.0194)	(0.0216)
SES quartile 4	--	0.0605***	0.0256	--	-0.0521***	-0.0411**	--	0.0374*	0.0053
	--	(0.0200)	(0.0245)	--	(0.0160)	(0.0195)	--	(0.0199)	(0.0249)
GPA	--	0.1392***	0.1465***	--	-0.0996***	-0.1039***	--	0.0887***	0.0941***
	--	(0.0103)	(0.0118)	--	(0.0085)	(0.0097)	--	(0.0103)	(0.0113)
AP courses	--	-0.0691***	-0.0630***	--	0.0571***	0.0500***	--	-0.0389***	-0.0382***
	--	(0.0131)	(0.0140)	--	(0.0081)	(0.0089)	--	(0.0117)	(0.0127)
Standardized math score	--	0.0509***	0.0509***	--	-0.0401***	-0.0402***	--	0.0349***	0.0349***
	--	(0.0112)	(0.0112)	--	(0.0086)	(0.0087)	--	(0.0113)	(0.0114)
Standardized reading score	--	0.0261**	0.0231**	--	-0.0217***	-0.0197**	--	0.0188*	0.0173*
	--	(0.0104)	(0.0105)	--	(0.0078)	(0.0080)	--	(0.0101)	(0.0104)
SAT (in 100s)	--	0.0076	0.0089	--	0.0010	-0.0008	--	0.0012	0.0000
	--	(0.0057)	(0.0065)	--	(0.0045)	(0.0051)	--	(0.0059)	(0.0066)
Plays sport	--	0.0258**	0.0252**	--	-0.0137	-0.0140	--	0.0181*	0.0165
	--	(0.0114)	(0.0118)	--	(0.0088)	(0.0091)	--	(0.0110)	(0.0114)
At least on parent college graduate	--	--	0.0238	--	--	-0.0097	--	--	0.0150
	--	--	(0.0153)	--	--	(0.0114)	--	--	(0.0154)
Parent's native language is English	--	--	0.0078	--	--	-0.0074	--	--	0.0012
	--	--	(0.0148)	--	--	(0.0118)	--	--	(0.0149)
-High school and region characteristics controls:	No	No	Yes	No	No	Yes	No	No	Yes
Observations	5970	5970	5970	5970	5970	5970	5300	5300	5300
First Stage F-Statistic	128.3	77.8	101.4	128.3	77.8	101.4	123.2	57.6	97.5
Hausman Test - χ^2 p-values	--	--	0.168	--	--	0.759	--	--	0.115
LM Wald Test - χ^2 p-values	--	--	0.314	--	--	0.733	--	--	0.151

Note: Results are from linear probability model. Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. The formal instrument is Ratio of Count of Common Application Colleges within 300 miles to All Colleges within 300 miles. High school characteristics include number of guidance counselors, number of students, public or private, urbanicity, percent free lunch, percent minority, and student-teacher ratio. Region characteristics include the number of colleges within 300 miles of the students home and the average SAT score of those colleges.

Table 6: Effect of Number of Applications on College Enrollment
OLS and Instrumental Variables Estimates
Robustness Checks

	Binary Dependent Variable:														
	Enrolls in College					*Rejected From All Colleges*					*Enrolls Given Accepted*				
	Baseline (All states, 300 miles)	*Excludes MA, NY, PA, CA, OH*	*Excludes New England and Mid-Atlantic*	*200 miles*	*400 miles*	*Baseline (All states, 300 miles)*	*Excludes MA, NY, PA, CA, OH*	*Excludes New England and Mid-Atlantic*	*200 miles*	*400 miles*	*Baseline (All states, 300 miles)*	*Excludes MA, NY, PA, CA, OH*	*Excludes New England and Mid-Atlantic*	*200 miles*	*400 miles*
OLS															
Number of applications	0.0324***	0.0361***	0.0345***	0.0318***	0.0329***	-0.0241***	-0.0275***	-0.0255***	-0.0239***	-0.0242***	0.0167***	0.0177***	0.0183***	0.0161***	0.0171***
	(0.0024)	(0.0032)	(0.0028)	(0.0024)	(0.0024)	(0.0017)	(0.0024)	(0.0020)	(0.0017)	(0.0017)	(0.0021)	(0.0029)	(0.0025)	(0.0021)	(0.0021)
Observations	5970	4260	4754	5970	5970	5970	4260	4754	5970	5970	5300	3750	4202	5300	5300
R-Squared	0.285	0.282	0.290	0.286	0.285	0.224	0.221	0.231	0.226	0.224	0.139	0.138	0.143	0.139	0.139
Instrumental Variables															
Number of applications	0.0613***	0.0889**	0.0828*	0.0536**	0.0629***	-0.0290*	-0.0277	-0.0520	-0.0346**	-0.0384***	0.0466***	0.0764**	0.0635	0.0353*	0.0408***
	(0.0199)	(0.0353)	(0.0471)	(0.0221)	(0.0153)	(0.0150)	(0.0259)	(0.0374)	(0.0167)	(0.0116)	(0.0178)	(0.0311)	(0.0459)	(0.0197)	(0.0137)
Observations	5970	4260	4750	5970	5970	5970	4260	4750	5970	5970	5300	3750	4200	5300	5300
R-Squared	0.271	0.244	0.254	0.278	0.269	0.224	0.221	0.211	0.222	0.218	0.115	0.066	0.096	0.129	0.124

Note: Results are from linear probability model. Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. The adoption rate instrument is the Ratio of Count of Common Application Colleges within 300 miles to All Colleges within 300 miles (or 200 miles or 400 miles). All regressions control for student characteristics, which include gender, race, high school GPA, SAT, and standardized test scores, whether played a sport, and SES quartile. Controls for parent characteristics include parents' education and native language, family composition. High school characteristics include number of guidance counselors, number of students, public or private, urbanicity, percent free lunch, percent minority, and student-teacher ratio. Region characteristics include the number of colleges within 200, 300, or 400 miles of the students home and the average SAT score of those colleges.

Table 7: Effect of Number of Applications on College Enrollment
Heterogeneous Effects by SES
Instrumental Variables
Instrument: Adoption Rate of Common Application Colleges within 300 miles of Student's Home

	Binary Dependent Variable:														
Variable	*Enrolls in College*					*Rejected From All Colleges*					*Enrolls Given Accepted*				
	All	SES1	SES2	SES3	SES4	All	SES1	SES2	SES3	SES4	All	SES1	SES2	SES3	SES4
Number of applications	0.0613***	0.1808*	0.1826	0.0498	0.0288	-0.0290*	-0.0910	-0.1746	-0.0384	0.0138	0.0466***	0.1226	0.0904	0.0267	0.0403*
	(0.0199)	(0.1036)	(0.1337)	(0.0403)	(0.0255)	(0.0150)	(0.0887)	(0.1185)	(0.0298)	(0.0157)	(0.0178)	(0.0781)	(0.1307)	(0.0384)	(0.0233)
Observations	5970	810	1060	1660	2540	5970	810	1060	1660	2540	5300	610	870	1400	2420
R-Squared	0.271	0.213	0.121	0.264	0.179	0.224	0.290	0.000	0.189	0.101	0.115	0.084	0.105	0.154	0.041

Note: Results are from linear probability model. Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. The adoption rate instrument is the Ratio of Count of Common Application Colleges within 300 km to All Colleges within 300 miles. Student characteristics include gender, race, high school GPA, SAT, and standardized test scores, whether played a sport, and SES quartile. Parent characteristics include parents' education and native language, family composition. High school characteristics include number of guidance counselors, number of students, public or private, urbanicity, percent free lunch, percent minority, and student-teacher ratio. Region characteristics include the number of colleges within 300 miles of the students home and the average SAT score of those colleges. The coefficients by SES do not statistically differ from one another accept for SES1 and SES3 when using the dependent variable "Rejected From All Colleges."

Table 8: Effect of Number of Applications on College Enrollment
Non-Linear Effects
OLS and Instrumental Variables

	Binary Dependent Variable:					
OLS	*Enrolls in College*		*Rejected From All Colleges*		*Enrolls Given Accepted*	
One Application	-0.2290***	--	0.2215***	--	-0.1102***	--
	(0.0151)	--	(0.0136)	--	(0.0173)	--
One or Two Applications	--	-0.1514***	--	0.1163***	--	-0.0791***
	--	(0.0106)	--	(0.0075)	--	(0.0103)
Observations	5970	5970	5970	5970	5300	5300
R-Squared	0.305	0.293	0.273	0.234	0.142	0.142
Instrumental Variables						
One Application	-0.4772***	--	0.2256*	--	-0.3714**	--
	(0.1587)	--	(0.1158)	--	(0.1451)	--
One or Two Applications	--	-0.3277***	--	0.1549*	--	-0.2634***
	--	(0.1071)	--	(0.0804)	--	(0.1009)
Observations	5970	5970	5970	5970	5300	5300
R-Squared	0.260	0.258	0.273	0.231	0.084	0.086
First Stage F-Statistic	32.4	53.4	32.4	53.4	32.2	48.7

Note: Results are from linear probability model. Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. The formal instrument is Ratio of Count of Common Application Colleges within 300 miles to All Colleges within 300 miles. Controls for student characteristics include gender, race, high school GPA, SAT, and standardized test scores, whether played a sport, and SES quartile. Controls for parent characteristics include parents' education and native language, family composition. High school characteristics include number of guidance counselors, number of students, public or private, urbanicity, percent free lunch, percent minority, and student-teacher ratio. All regressions also control for the number of colleges within 300 miles of the students home and the average SAT score of those colleges.

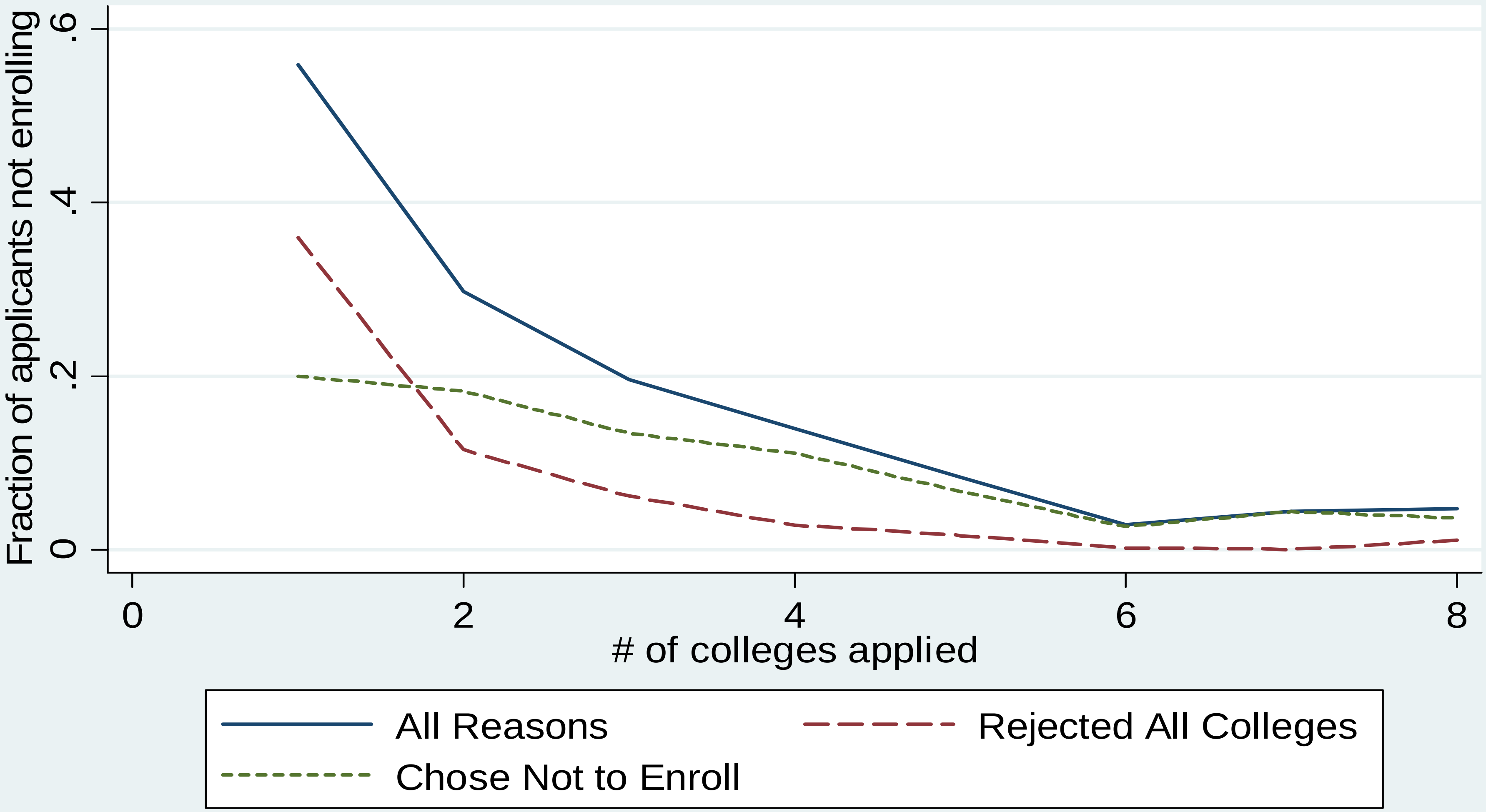
Table 9: Effect of Number of Applications on College Enrollment
Non-Linear Effects
Omitted Variable = More than 5 Applications
OLS

	Binary Dependent Variable		
Dummy Variable	*Enrolls in College*	*Rejected From All Colleges*	*Enrolls Given Accepted*
One Application	-0.2841***	0.2339***	-0.1522***
	(0.0179)	(0.0141)	(0.0192)
Two Applications	-0.1025***	0.0382***	-0.0741***
	(0.0139)	(0.0086)	(0.0133)
Three Applications	-0.0274**	-0.0036	-0.0251*
	(0.0137)	(0.0078)	(0.0129)
Four Applications	-0.0186	-0.0197***	-0.0300**
	(0.0149)	(0.0072)	(0.0141)
Five Applications	0.0071	-0.0130*	-0.0010
	(0.0145)	(0.0072)	(0.0135)
Observations	5970	5970	5300
R-Squared	0.313	0.277	0.147

Note: Results are from linear probability model. Robust standard errors in parenthesis. *** is significant at 1%, ** is significant at 5%, at * is significant at 10%. Controls for student characteristics include gender, race, high school GPA, SAT, and standardized test scores, whether played a sport, and SES quartile. Controls for parent characteristics include parents' education and native language, family composition. High school characteristics include number of guidance counselors, number of students, public or private, urbanicity, percent free lunch, percent minority, and student-teacher ratio. All regressions also control for the number of colleges within 300 miles of the students home and the average SAT score of those colleges.

Figure 1: Students Not Enrolling in 4-Year College

Applied to at least one college*



*Number of colleges top-coded at eight.

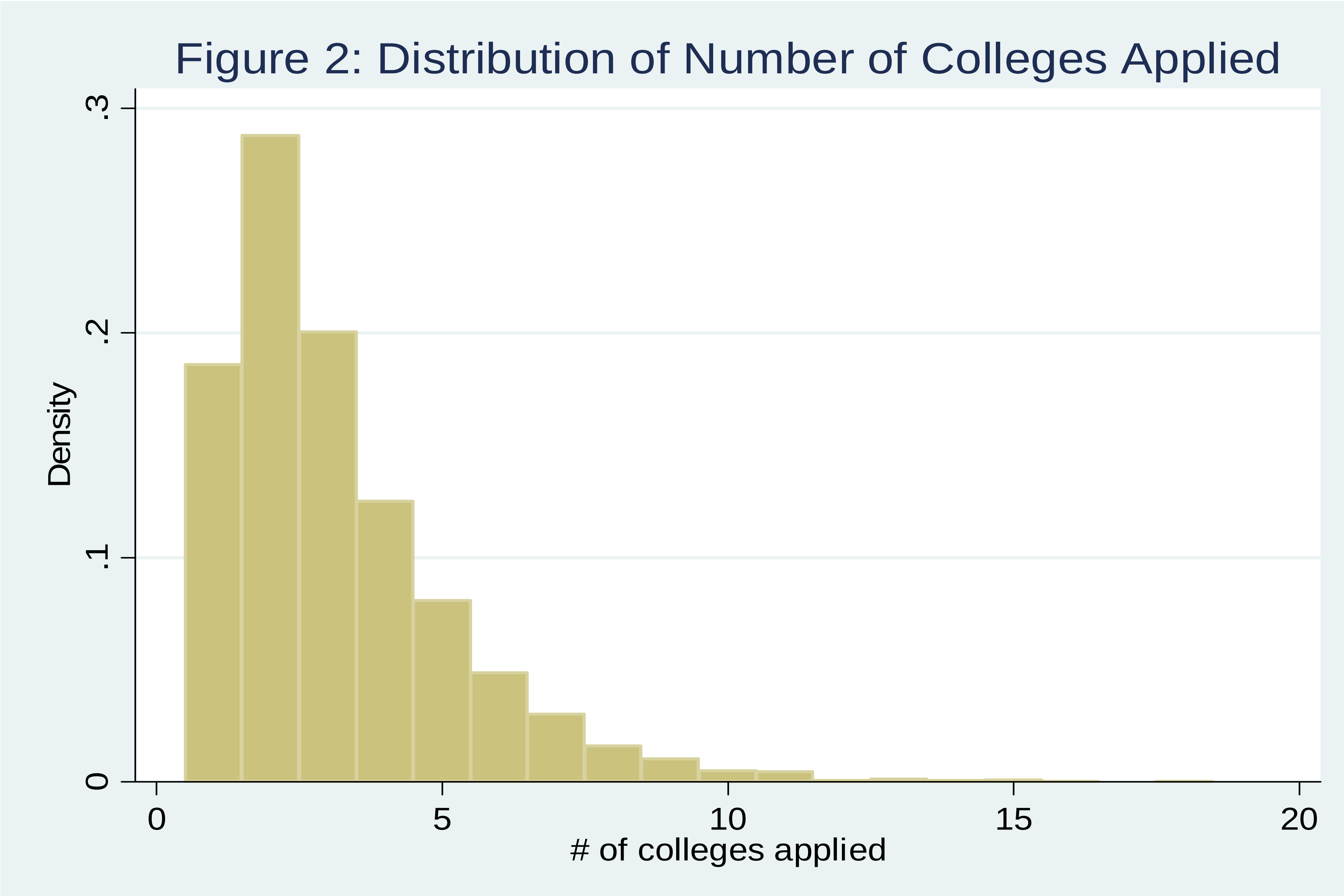


Figure 2: Distribution of Number of Colleges Applied
Density
0
.1
.2
.3
0
5
10
15
20
# of colleges applied

Figure 3: Number of Common Application Colleges by State

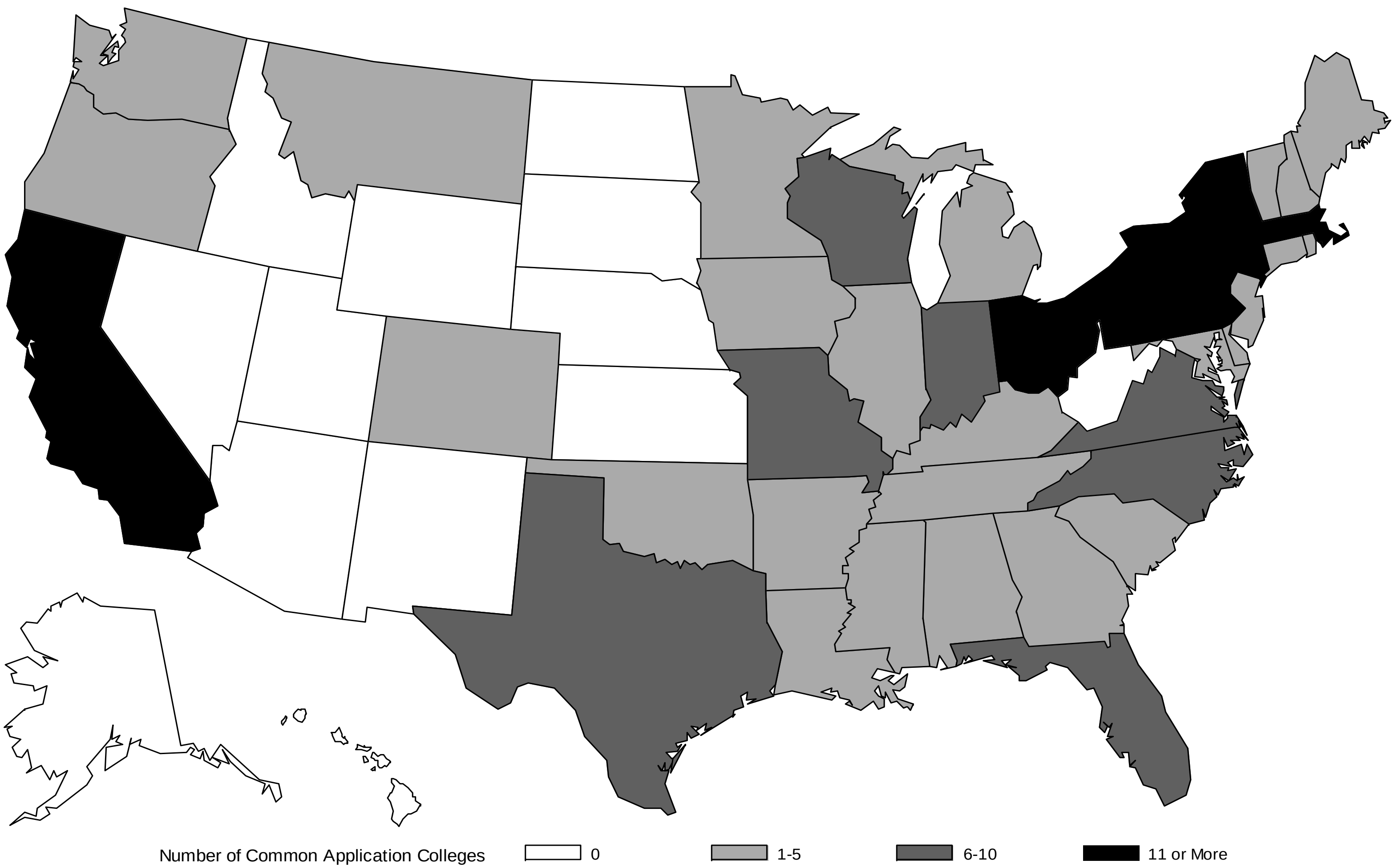
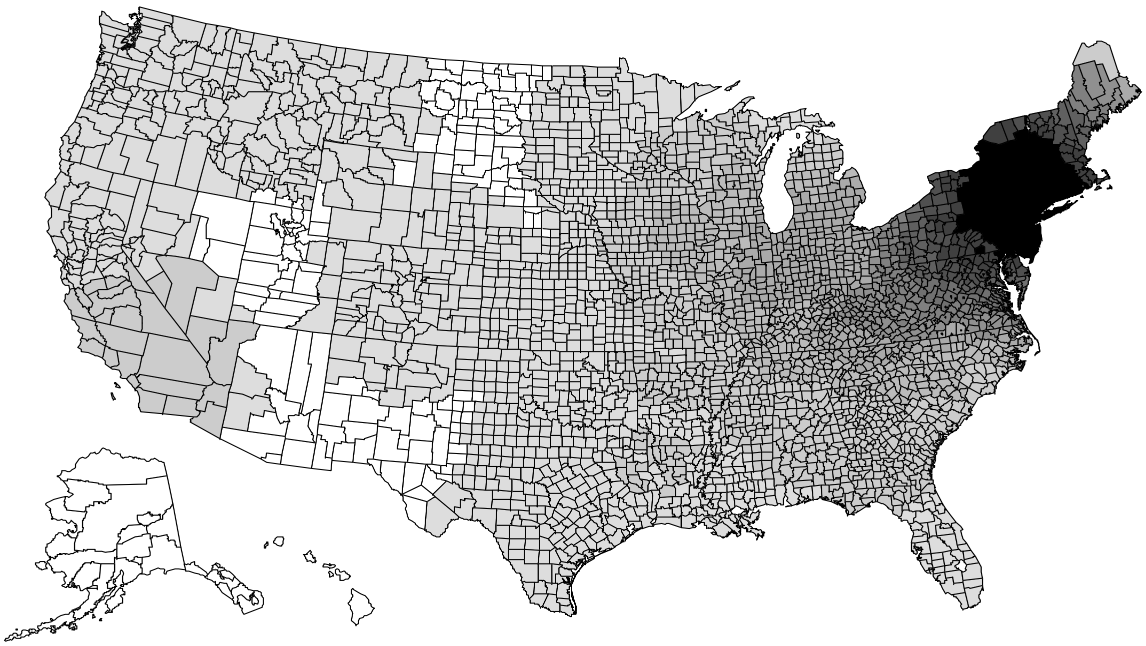


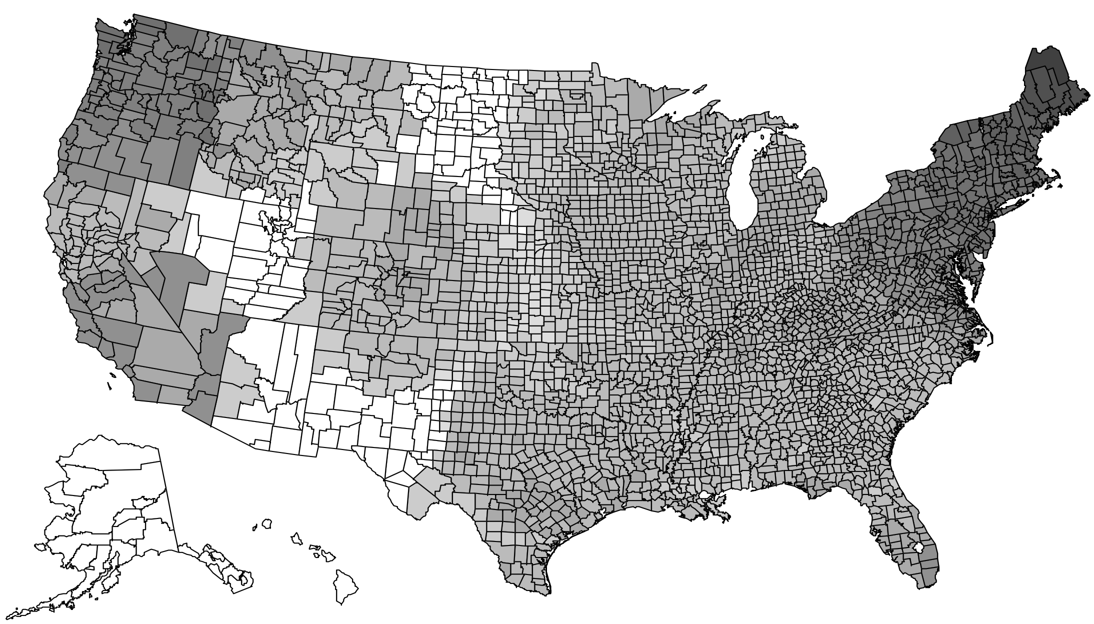
Figure 4: Common Application Colleges within 300 Miles of County

Absolute Number of Common Application Colleges within 300 Miles of County



Number of Common Application Colleges within 300 Miles of County: 0; 1-10; 11-20; 21-30; 31-40; 41-50; 51-60; 61-70; 71-80; 81-90; 91-100; > 100

Relative Number of Common Application Colleges within 300 Miles of County
(Ratio of Number of Common Application Colleges within 300 Miles of County to Number of All Colleges within 300 Miles)



Ratio of Common Application Colleges within 300 Miles of County: 0; > 0.00 to 0.05; > 0.05 to 0.10; > 0.10 to 0.15; > 0.15 to 0.20; > 0.20 to 0.25; > 0.25 to 0.30; > 0.30 to 0.35; > 0.35 to 0.40; > 0.40 to 0.45; > 0.5

Appendix 1: College Characteristics - Common Application and Non-Common Application Colleges								
	Non-Common Application Colleges (obs = 1,060)				Common Application Colleges (obs = 250)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Public College	0.39	0.49	0	1	0.03	0.18	0	1
Average SAT of Enrolled	1047	104	730	1510	1212	121	885	1490
Number of Undergraduates	4,714	7,716	39	114,250	3,139	3,286	398	19,175
Acceptance Rate	0.70	0.17	0.05	1	0.58	0.19	0.09	0.87
Graduation Rate	0.470	0.195	0	1	0.73	0.12	0.42	0.98
Tuition per Full Time Equivalent	11,902	7,410	0	37,312	25,302	6,449	6,057	48,528
NCAA Member	0.65	0.48	0	1	0.95	0.22	0	1
Catholic	0.11	0.32	0	1	0.16	0.37	0	1