Reducing Frictions in College Admissions: Evidence from the Common Application∗

Preliminary, Do Not Cite

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March 19, 2019

Abstract

College admissions in the U.S. is decentralized, with separate applications for each school. This creates frictions in the college admissions process and, if substantial, ultimately limits student choice. In this paper, we study the introduction of the Common Application (CA), under which students can submit a single application to all member schools, potentially reducing frictions and increasing student choice. We first document that, when joining the CA, schools receive more applications, consistent with reduced frictions, but also experience lower yield on their acceptances, consistent with increased student choice. For these reasons, schools become more selective but admit more students in total. In line with these findings, we document that the CA has accelerated geographic integration: upon joining, schools attract more foreign students and more out-of-state students, especially from other states with significant CA membership, consistent with network effects. Finally, we find some evidence that, upon joining the CA, schools experience increased freshmen SAT scores. If so, and given that CA members tend to be more selective institutions, this has contributed to stratification, the widening gap between more selective and less selective schools.

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1 Introduction

In the United States, college admissions follows a decentralized process. More specifically, students first choose the set of schools to which to apply. Schools then independently decide whether or not to make admissions offers to these applicants. Finally, students select from their choice set, the institutions to which they were offered admissions. Historically, students have completed separate applications for each school, entailing substantial time costs, or frictions. This is in addition to the substantial information frictions facing students as a result of decentralized college admissions.

These frictions in college admissions may limit student applications and may ultimately reduce the size of student choice sets. Since students tend to attend colleges close to home, these frictions may also lead to a market that is less integrated than is ideal from a geographic perspective. At the same time, substantial frictions might also lead to less sorting across schools according to ability, with schools being less stratified than they would be under a more centralized college admissions process.

In this paper, we investigate the introduction of the Common Application (CA), a consortium of schools that allows students to complete one application for multiple institutions. The CA started in 1975 with 15 members, all private schools in the Northeast, and today has over 750 members, both public and private institutions spread throughout the country. The CA, by allowing students to submit a single application to multiple institutions, may significantly reduce frictions. By providing a centralized information portal, the CA might also reduce information frictions. Given these reductions in frictions, the CA might increase student choice sets, in turn leading to increased geographic integration but also increased stratification across institutions.

Given this motivation, we ask a series of research questions in this paper. First, has the CA reduced frictions, resulting in more college applications at member institutions and increased student choice sets? Second, how have university admissions policies changed in response to this change in their applicant pool? Third, has the CA led to a more geographically integrated market, with more students attending CA institutions far from home? And, if so, by increasing student choices and integrating the market geographically, has the CA contributed to stratification, a widening of the selectivity gap between more selective and less selective institutions?

To investigate these questions, we first present a simple model of the college admissions process. In the model, students, facing uncertain admissions decisions, first choose the set of schools to which to apply. Based upon this applicant pool, schools then make admissions offers. Finally, students select from their choice set, the institutions to which they were offered admissions. In the context of this model, we consider the impacts of the CA, under which
schools use a single application, reducing the costs of applying to additional schools in the set once a student has applied to at least one CA school.

The model makes a series of predictions. First, due to a reduction in frictions, schools joining the CA experience an increase in applications. Second, consistent with larger student choice sets, schools joining the CA experience a reduction in their yield. Third, given this change in applications, schools reduce their admissions rate but admit more applicants in total. Fourth, the CA contributes towards geographic integration, with students traveling further to attend CA institutions. Finally, in an extension of the model that includes students of heterogeneous ability, the introduction of the CA increases stratification, with high ability students disproportionately sorting into CA schools.

We then test the implications of this model use panel data from 1990 to 2015 on university outcomes, such as the number of applications and the number of accepted students. We also investigate the geographic distribution of enrolled students and SAT scores for enrolled students. Exploiting the staggered adoption of the CA over time, these data on school and student outcomes are combined with information on the entry year for each CA member. We estimate both two-way fixed effects models, comparing outcomes for schools before and after joining CA, and also provide event studies, investigating the timing of any effects associated with entry into the CA.

Our results suggest that CA entry increases applications, consistent with a reduction in frictions, and reduces yield, consistent with larger student choice sets. We find some evidence that schools respond to this change in their pool of applicants by reducing their admissions rate but, facing lower yield, by admitting more students in total. We also find evidence that the CA has accelerated geographic integration. In particular, entry into the CA is associated with an increase in the fraction of out-of-state students, an increase in the fraction of international students, and a general widening of the geographic distribution of enrollees. Further, the enrollment patterns before and after entry are consistent with the presence of network effects. In particular, entry into the CA is associated with increased enrollment from other states with significant CA penetration. Regarding stratification, we find some evidence that entry into the CA is associated with an increase in SAT scores at the 75th percentile. Combined with the fact that CA entry has been more common among selective institutions, the CA may have led to increased stratification, a widening of the gap between more selective and less selective institutions.

The paper proceeds as follows. Following the discussion of the relevant academic literature, we offer more details on the CA. This is followed by the presentation of the theoretical model of the college admissions process. We then describe the data and empirical approach. This is
followed by a presentation of the key empirical results, and the final section concludes.

2 Related Literature

This paper is related to a literature on frictions in college admissions and interventions designed to reduce such frictions. Hoxby and Avery [2013] document substantial information frictions in the US, with many low-income but high-ability students not applying to selective colleges, despite generous financial aid available at these institutions. In a random controlled trial, Hoxby and Turner [2014] and Hoxby and Turner [2015] provide these high-ability but low-income students with information about college admissions and financial aid. They document that the intervention increased applications to, and ultimately attendance at, selective institutions. In the context of financial aid policy, Bettinger et al. [2012] conduct a field experiment in which individuals were provided assistance filling out the FAFSA, a complex financial aid application, and show that this intervention increased aid receipt, college attendance, and persistence. Bird et al. [2017] conduct a field experiment using the Common Application platform and document that providing information about financial aid increases college attendance and especially so for first-generation college students.

Another literature has examined how college admissions, and in particular the recent increase in the number of applications per student, has changed both student behavior and university behavior. Bound et al. [2009] document increases over time in the number of students applying to college, increases over time in applications per student, and reductions in acceptance rates at selective institutions. Students have strategically responded to this increased competition in ways designed to improve their likelihood of admission to selective institutions. Avery and Levin [2010] document that early applicants are more likely to be admitted, when compared to the regular applicant pool. In a theoretical model, they argue that this finding is consistent with an early application serving as a signal of student enthusiasm for attending the institution. Avery et al. [2013] argue that standard methods of ranking colleges, such as the U.S. News and World Report, provide incentives for institutions to manipulate admissions decisions to reduce acceptance rates and to increase yield, the fraction of admitted students who accept their offers.

This paper also is related to a literature on geographic integration in higher education. Historically, the US market for higher education was highly localized with most students attending university close to their residence. In 1949, 93 percent of students attended university in their home state [Hoxby, 2000]. In a series of papers, Hoxby argues that one of the most substan-

\footnote{Outside of the US, Gibbons and Vignoles [2012] study student college decisions in England and find that conditional on going to college, distance is the most important factor in explaining choice of college.}
tial changes to the US college market since 1940 is a large increase in geographic integration, which led to both higher tuition and greater student sorting [Hoxby, 1997, 2000, 2009]. Despite this large increase, the US market may still be considered local in nature, with 79 percent of first-time students enrolled in a college in their home state in the fall of 2014. Knight and Schiff [2019] and Cohodes and Goodman [2014] argue that financial incentives, in the form of in-state tuition discounts and financial aid for in-state institutions, have contributed to this high degree of attendance at in-state public institutions. New technologies, such as the CA, may disrupt these patterns. Deming, Lovenheim, and Patterson [2016], for example, argue that less-selective colleges are particularly localized and study the effect of competition from online degree programs in these markets, finding that online competition can reduce enrollment at private non-selective institutions.

On the effects of CA, Smith [2013] studies the effect of the number of applications on enrollment probabilities, using variation induced by the CA, and finds that increasing the number of applications significantly increases enrollment probabilities. Smith, Hurwitz, and Howell [2015] study the responsiveness of students to various features of the application process, finding some evidence that the CA increases applications while fees and essay requirements decrease applications. Perhaps the paper most closely related to this one is Liu et al. [2007], who use panel data from the College Board to study how CA membership affects admissions outcomes as well as the composition of enrollees. While their paper has a stronger focus on student characteristics, such as race and SAT scores, we are more interested in the role the CA has played in terms of student choice and geographic integration.

3 Background

While the CA began with just 15 colleges in 1975, it currently includes over 700 institutions, who, at current, receive more than 4 million applications from over 1 million students on an annual basis. In Figure 1, we document increases in membership in every year since 1975 and a significant acceleration of membership starting around 2000.

The CA was started by a small set of liberal arts colleges but has since expanded to a wide range of public and private institutions, especially more selective institutions. In particular, as shown in Figure 2, membership among the top 50 liberal arts colleges was already very high, over 80 percent, in 1990, the beginning of our analysis, and was universal in this group.

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by the late 1990s. During our sample period, membership among top 50 private institutions increased rapidly, from under 40 percent in 1990 to roughly 90 percent by 2015. Membership among less selective liberal arts colleges and other private institutions also increased during our sample period but remained below 50 percent by 2015. Regarding public institutions, the CA was closed to this group until 2002. Following the option for public institutions to join, membership increased rapidly among the top 50 public institutions, with roughly one-third of these institutions members of the CA by the end of our sample period. Less selective public institutions, by contrast, joined at a slower rate, with membership still below 20 percent by the end of our sample period.

In addition to rapid entry during our sample period overall, the CA has also become more diverse from a geographic perspective. That is, the CA started as a consortium of liberal arts colleges in the Northeast but is now accepted by colleges in many different states. In particular, Figure 3 plots the locations of CA members in 1986 and 2014, showing a significantly wider geographic distribution in the latter year, with significant new penetration in states such as California, Oregon, Colorado, Indiana, and Florida. Given this substantial adoption over time and a diverse set of members at current, it is natural that the CA may have led to significant changes in college admissions.

Figure 1: Common Application Membership by Year
4 Theoretical Model

In order to better understand the potential effect of the CA on student and university outcomes, we next present a simple model of the college admissions process. The model has three distinct stages. First, students decide which colleges to apply to. Second, colleges make admissions offers. Finally students decide which college to attend given these admissions offers.
4.1 Setup

Consider a college applications environment in which there are two colleges: \( c = 1 \) and \( c = 2 \). Students receive a payoff \( V_c \) from attending college \( c \):

\[ V_c = U_c + \varepsilon_c \]

(1)

The first term \( U_c \) is known prior to applying and may include residency status, reflecting a preference for local colleges, due to either a preference for proximity or lower in-state tuition at public institutions. The second term, which we assume is distributed type-1 extreme value, is revealed after the student is accepted to college \( c \) but before she has made her enrollment choice. Not attending college is also an option, which we denote \( c = \emptyset \) and normalize with \( U_\emptyset = 0 \). There are two types of students, each representing one-half of the population. The first type prefers college 1 over college 2, and the second prefers college 2 over college 1. We assume symmetry, such that \( U_1 - U_2 = \delta > 0 \) for the first type and \( U_2 - U_1 = \delta > 0 \) for the second type. While we focus below on type-1 students, similar derivations apply for type 2 students given the symmetry of the model.

When applying, students pay an application fee of \( F \) to the first college and a potentially lower fee (\( f \leq F \)) when applying to a second college. The Common Application can be interpreted as a reduction in \( f \) from \( f = F \) in the sense that the application developed for the first choice college can also be used for the second college. After student application decisions and university admissions offers there are four possible student choice sets:

\[ \bigcup_{k=1}^{4} S_k = \{ \emptyset \}, \{ 1 \}, \{ 2 \}, \{ 1, 2 \} \]

(2)

Following the standard formula for consumer surplus in a logit model, the ex-ante value of choice set \( S \) is:

\[ C(S) = \ln \left[ \sum_{c \in S} \exp(U_c) + \exp(0) \right] \]

(3)

For example, the student’s ex-ante value of being able to choose between colleges 1 and 2 equals \( C(\{1, 2\}) = \ln[\exp(U_1) + \exp(U_2) + \exp(0)] \). To simplify notation, we also refer to this as \( C_{12} \). An important feature of the model is that \( C_1 + C_2 > C_{12} \), meaning that the marginal value of an additional option is declining in the size of the choice set.

Let the acceptance rate at college \( c \) be \( Q_c \), which will be determined in equilibrium. Given the four choice sets, there are also four corresponding application sets. Define \( A(S) \) as the value from applying to the colleges in set \( S \); this will depend on the expected value of all
possible acceptance events within \( S \). Let \( \Omega(S) \) denote the set of possible acceptance events from applying to college set \( S \) and let \( F(S) \) be the application cost of that set. For example, a student who applies to college set \( S = \{1, 2\} \) will have possible acceptance events \( \Omega(S) = \{\emptyset\}, \{1\}, \{2\}, \{1, 2\} \) and an application cost of \( F(S) = F + f \). Then the value of any application set \( S \) is:

\[
A(S) = \left[ \sum_{k \in \Omega(S)} Q(\{k\}) \cdot C(\{k\}) \right] - F(S) \quad (4)
\]

Using equation 4, the value from, for example, a type 1 student applying to both colleges equals

\[
A(1, 2) = Q_1 Q_2 C(1, 2) + Q_1 (1 - Q_2) C_1 + (1 - Q_1) Q_2 C_2 - F - f.
\]

To simplify notation, we also refer to this as \( A_{12} \). In equilibrium, a key issue will involve whether students choose to apply to only one college or to both colleges. Type 1 students, conditional on applying to college 1, should also apply to college 2 if the application value of both is higher than only applying to 1 \((A_{12} > A_1)\). This holds under the following condition:

\[
\frac{Q_1 Q_2 (C_{12} - C_1)}{\text{option-value}} + (1 - Q_1) Q_2 C_2 \geq f \quad (5)
\]

The first part of equation 5 we have labeled as “option-value” since it represents the value of having the additional option to attend college 2 when the student has also been accepted to college 1; this event occurs with probability \( Q_1 Q_2 \). This option value captures the idea that students may learn that college 2 is actually preferred to college 1 throughout the admissions process, following the realization of \( \epsilon_1 \) and \( \epsilon_2 \). The second part is the “safety-value,” or the value of being able to choose college 2 if not admitted to college 1, and this event occurs with probability \((1 - Q_1) Q_2\). Both parts of this equation are increasing in the utility of, and probability of admittance to, college 2, \( U_2 \) and \( Q_2 \).

On the supply side, we assume that colleges have a fixed capacity and can serve a fraction \( 0 < \kappa < 1 \) of the students for whom the college is their first choice. Thus, \( 2\kappa \) represents the overall capacity across the two institutions. These capacities, along with student applications, determine equilibrium admissions rates.

### 4.2 Equilibrium

Working backwards, we begin with the final stage: student college choices given admissions offers. For type 1 students admitted to only college 1, yield, or the probability of accepting this admissions offer over not attending college, is given by:
\[ Y_1 = \frac{\exp(U_1)}{1 + \exp(U_1)} \]  

A similar expression applies to the yield for college 2, with \( Y_1 > Y_2 \). For students accepted to both colleges, we denote \( Y_{12} \) as the yield for the first-choice college and \( y_{12} \) as the yield for the second-choice college. These are given by:

\[ Y_{12} = \frac{\exp(U_1)}{1 + \exp(U_1) + \exp(U_2)} \]  

\[ y_{12} = \frac{\exp(U_2)}{1 + \exp(U_1) + \exp(U_2)} \]

An important feature of the model is that \( Y_{12} + y_{12} > Y_1 \), meaning that having a larger choice set makes students more likely to attend college. This results from the possibility of choosing the ex-ante second choice over the ex-ante first choice in the event that not attending college also dominates, ex-post, the ex-ante first choice.

Working backwards to the second stage, and, given these yields, schools then set their admission rates in order to satisfy their capacity constraint. We focus here on an equilibrium in which a fraction \( b \in (0, 1) \) of students apply to both colleges and a fraction \( 1 - b \) only apply to their first-choice college. Then, admissions rates in a symmetric equilibrium are set such that the number of acceptances of admissions offers equals the overall university capacity:

\[ Q \left[ (1 - b)Y_1 + bQY_{12} + b(1 - Q)Y_1 \right] + Q \left[ bQy_{12} + b(1 - Q)Y_2 \right] = \kappa \]

In this equation, the first term represents yield on first-choice students. A fraction \( 1 - b \) apply to only their first choice, with yield of \( Y_1 \), and a fraction \( b \) also apply to their second choice. In the latter case, a fraction \( Q \) are also admitted to their second choice, with yield of \( Y_{12} \), and a fraction \( 1 - Q \) are denied admission to their second choice, with yield equal to \( Y_1 \). The second term represents yield on second-choice students, among whom a fraction \( b \) apply to both colleges. Among these students, a fraction \( Q \) are also admitted to their first choice and yield thus equals \( y_{12} \). The remaining fraction \( (1 - Q) \) are not admitted to their first choice and yield on these students thus equals \( Y_2 \).

Then, working backwards to the first stage of the model, student application decisions, the relevant measure is the fraction \( b \) applying to both colleges and the fraction \( 1 - b \) applying to only their first choice college. In equilibrium, the number applying to their second choice will increase until the benefits from a second application equal the costs of a second application.
This condition, setting equation 5 to equality and imposing symmetry, is given by:

\[ Q^2(C_{12} - C_1) + (1 - Q)QC_2 = f \]  

(10)

### 4.3 Solution

Given this, equations 9 and 10 represent two equations with two unknowns: the fraction of students applying to both colleges \(b\) and the university admissions rate \(Q\). For simplicity, we assume here an interior solution, such that \(0 < b < 1\) and \(0 < Q < 1\). The Appendix outlines the conditions for an interior solution.

We solve these equations as follows. First, we can solve equation 10 for the equilibrium admissions rate via the quadratic formula. While this equation is quadratic in \(Q\) and thus has two solutions in principle, the upper solution implies an admissions rate in excess of 1.\(^4\) Given this, we focus on the lower solution:

\[ Q^* = \frac{C_2 - \sqrt{C_2^2 - 4f(C_1 + C_2 - C_{12})}}{2(C_1 + C_2 - C_{12})} \]  

(11)

The numerator is positive since the first term is larger than the second term, and denominator is also positive since, as noted above, \(C_1 + C_2 > C_{12}\).

Given this equilibrium admissions rate, one can then calculate the equilibrium fraction of students applying to both colleges via equation 9. In particular, the fraction applying to both equals:

\[ b^* = \frac{\kappa - QY_1}{Q^2[Y_{12} + Y_{12} - Y_1] + Q(1 - Q)Y_2} \]  

(12)

where \(Q\) is set at equilibrium levels.

We provide a graphical interpretation of these results in Figure 1 below. As shown, the initial equilibrium, in admissions rates and applications activity, occurs at the intersection between the student indifference condition, which determines admission rates in equilibrium, and the college feasibility constraint, which requires a reduction in admissions rates given an increase in the number of applications received. This results in an equilibrium with admissions rates \(Q^*\) and applications rate \(b^*\) such that college feasibility is satisfied and students are indifferent between submitting one application and submitting two applications.

\(^4\)For the upper solution to be less than 1, it must be the case that \(C_2 + \sqrt{C_2^2 - 4f(C_1 + C_2 - C_{12})} < 2(C_1 + C_2 - C_{12})\). Since \(f(C_1 + C_2 - C_{12}) > 0\), the left-hand side is greater than \(2C_2\) and thus cannot be less than \(2(C_1 + C_2 - C_{12})\) since \(C_{12} > C_1\).
4.4 Effect of the Common Application

We next consider a comparative static under which the cost of applying to a second college falls from $F$ to $f$. We consider a marginal change and have the following results:

**Proposition:** Consider the introduction of the Common Application, with a marginal reduction in the cost of applying to a second college. There are four effects: 1) application activity increases due to an increase in the equilibrium fraction of students applying to both colleges ($b$). 2) Colleges become more selective, with a reduction in equilibrium admissions rates ($Q$). 3) Despite this increasing selectivity, universities accept a larger number of applications due to the reduction in yield on accepted students. 4) There is an increase in the number of students attending out-of-state institutions.

We provide graphical interpretation of these results in the context of Figure 4. As shown, given a reduction in $F$, students are no longer indifferent between applying to one institution and applying to both institutions at the initial admissions rate. In the absence of any adjustment in admissions rates ($Q$), the CA in fact drives student application behavior to a corner solution, with all students applying to both colleges ($b = 1$). Given this, admissions rates adjust in order to restore student indifference. In particular, admissions rates fall from $Q^*$ to $Q^{**}$, and the
equilibrium fraction of students applying to both colleges increases accordingly, from $b^*$ to $b^{**}$.

Despite the reduction in admissions rates, universities make more admissions offers in total, as described in the Proposition. This results from the fact that yield on admitted students falls under the Common Application as accepted students now tend to have larger choice sets. Thus, universities must admit more students in total in order to meet their capacity.

Finally, if we interpret first-choice colleges as tending to be in-state and second-choice colleges as tending to be out-of-state, we have that the Common Application leads to geographic integration, with more students attending out-of-state institutions. This results from more students applying to out-of-state institutions, which they might attend since, as described above, there is both an option value and a safety value from applying to out-of-state (i.e. second-choice) institutions.

4.5 Extension to Ability Types

To examine the possible effects of the CA on stratification, we next consider an extension of the model to ability types and more than two colleges. Details are provided in the Appendix, and here we simply describe the key results. In particular, there are three colleges, two in the CA and one outside of the CA, and two types of students, low-ability and high-ability. We assume that colleges want to attract as many high-ability students as possible and admit them with probability one. Low-ability students are then admitted at an endogenous admissions rate such that remaining capacity is filled. In the context of this model, we consider how the Common Application, and the associated geographical integration, might affect the allocation of high and low ability students across institutions. The key result involves stratification, with high ability students disproportionately attending Common Application schools, and low-ability students disproportionately attending schools outside of the Common Application. This results from the increased application activity among high ability students at Common Application schools. Although there is no safety value motivation, given that these high ability students are admitted to their first choice with certainty, there is an option value from additional applications.

5 Data and Estimation

5.1 Data

Our analysis uses two sources of data on universities, the College Board’s “Annual Survey of Colleges” and data from the Integrated Postsecondary Education Data System (IPEDS), com-
bined with the year in which each university became a member of the CA.\textsuperscript{5} We use the College Board data for much of our analysis on the effect of the CA on applications, admissions, and enrollment because it covers a longer time span (1990-2016) than similar data from the IPEDS. However, the IPEDS data has information on student migration conducted biennially from 1986 to 2014, and we use these data to study geographic integration.

5.2 Trends in Geographic Integration

Using the IPEDS migration data, we first present some general descriptive results on geographic integration in the US college market over time. Hoxby [2000] shows that the percentage of students attending in-state institutions fell consistently from 1949 to 1994 and that the role of distance in explaining college choice decreased as well. We extend this study of geographic integration by quantifying the change in the distance from a student’s home state to the state of their university, over the period from 1986 to 2014. To do so, we use the IPEDS migration data, which provides university enrollment by source state, and calculate the great circle distance in kilometers between state centroids, defining the distance for all in-state students as zero. In Figure 5 we plot the mean distance traveled in each year, along with 95% confidence intervals.\textsuperscript{6} The figure shows a clear increase from 1986 to 2014, with the average distance traveled increasing by over 100 kilometers for private universities and roughly 41 kilometers for public universities. We provide additional results on geographic integration in Appendix section A.4.

\textsuperscript{5}The CA entry year was provided to us by The Common Application organization.

\textsuperscript{6}Letting the subscript $s$ denote a student’s state, we define the mean distance traveled by all students from US states at college $c$ in year $t$ as $avdist_{c,t} = (1/nat\_enroll_{c,t}) \sum_{s \in S} enroll_{c,s,t} \times dist_{c,s}$. The variable $nat\_enroll$ is total enrollment from the 50 US states and D.C. The home location of foreign students and students from US territories is usually not available, and therefore we excluded these groups from the total. However, students from these groups are counted in total enrollment when calculating percentage of students attending in-state.
5.3 Specifications

We use two estimating equations in most of our analysis. We refer to these as a two-way fixed effects specification (TWFE) and an “event study” specification. In the TWFE specification we estimate a single coefficient for the effect of CA entry and include both institution fixed effects and year fixed effects. Letting \( c \) index colleges and \( t \) index time (year), our general TWFE specification for an outcome variable \( y_{ct} \) (e.g., applications and yield) is:

\[
\ln(y_{ct}) = \beta CA_{ct} + \mu_c + \mu_t + \epsilon_{ct}
\]  

where \( \mu_c \) is a college fixed effect, and \( \mu_t \) is a year fixed effect. Let \( J_c \) be the year college \( c \) joined the Common App; \( J_c = 0 \) if the college never joined. We use \( CA_{ct} \) to indicate whether college \( c \) was a member of the Common App in year \( t \). This term equals one if students applying in year \( t \) could use the CA at college \( c \): \( CA_{ct} = \{ t \geq J_c \} \). Then, the parameter \( \beta \) captures the effect of joining the CA on outcomes, after controlling for time effects and university effects.

Our event study specification, designed to measure the timing of any effects of entry, is
given by:

$$\ln(y_{ct}) = \sum_{k=-1}^{k=K} \beta_{t+k} \{t - J_c = k\} + \mu_c + \mu_t + \varepsilon_{ct}$$ (14)

where, as above, $\mu_c$ is a college fixed effect, and $\mu_t$ is a year fixed effect. We normalize $\beta_{t-1}$ to zero and hence the key parameter $\beta_{t+k}$ captures the effect of joining the CA at time $t$ on outcomes at time $t + k$, relative to outcomes at time $t - 1$.

6 Preliminary Results

6.1 Effect of CA Entry on Applications and Yield

We begin our analysis on the effect of joining the Common Application by showing results from estimating equation 13 using the College Board data from 1990-2016. In Table 1 all outcomes are in natural logs and coefficients can thus be interpreted as reflecting percent changes. As shown in the first column, applications are about 12 percent higher after a college joins the Common Application, relative to the period before they joined the CA. This is consistent with the CA reducing frictions in college applications. To investigate the role of pre-trends and to consider the dynamic effects of joining the CA, we next present results from estimating the event study specification and then plotting the relevant coefficients, along with 95 percent confidence intervals.\footnote{Standard errors are clustered at the institution level.} For ease of interpretation we normalize the coefficient one year before joining to zero ($\beta_{t-1} = 0$). As shown in Figure 6, there is a slight downward trend in applications before a school joins the CA. After joining the CA, there is a discontinuous 10 percent increase in the number of applications. The effect grows over time, rising to over 20 percent after one decade in the CA. There are at least two possible reasons for why the effects of CA might increase over time. First, the effect of the CA could be increasing over time due to the design of the platform, with, for example, the internet playing a large role in the success of the CA today. Second, there could be network effects, with larger effects as the number of CA members increases over time.
Table 1: Effect of CA Entry on Institutions

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All specifications include institution and year FE.
Standard errors clustered by institution (unitid).

Second, we investigate whether entry into the CA has led to a decrease in yield due to larger student choice sets. As shown in column 2 of Table 1, there is indeed a 9 percent reduction in yield in each year after a college joins the CA, relative to the period before they joined the CA. We next consider the event study specification for yield. Figure 7 shows an immediate reduction in yield after joining the CA, and this effect again becomes more pronounced over time. To summarize, we find strong evidence that CA entry is associated with an increase in the number of applications and a reduction in yield. These results suggest that joining the CA reduces frictions and increases the choice set available to students.
Given that yield depends upon enrollment and acceptances, a reduction in yield could be driven by either a reduction in enrollment, an increase in acceptances, or both. More formally, we can decompose the decrease in yield via the equation $\ln(yield) = \ln(enrollment) - \ln(acceptances)$. As shown in columns 3 and 4 of Table 1, the effect appears to be driven by a 12 percent increase in acceptances, an increase that is equivalent to the 12 percent increase in applications. We also find that enrollment increases 4 percent following CA entry. While schools may have been expanding capacity at the same time they adopted CA, it is also possible that some universities were not at full capacity before joining the CA.
Figure 8: Effect of CA Entry on Admissions

Event Study: CA entry and admits

Change in admits

t-12 t-11 t-10 t-9 t-8 t-7 t-6 t-5 t-4 t-3 t-2 t-1 t t+1 t+2 t+3 t+4 t+5 t+6 t+7 t+8 t+9 t+10 t+11 t+12
time to entry

Figure 9: Effect of CA Entry on Enrollment

Event Study: CA entry and enrollment

Change in enrollment

t-12 t-11 t-10 t-9 t-8 t-7 t-6 t-5 t-4 t-3 t-2 t-1 t t+1 t+2 t+3 t+4 t+5 t+6 t+7 t+8 t+9 t+10 t+11 t+12
time to entry
Finally, we investigate whether selectivity has changed, defined as $\ln(\text{selectivity}) = \ln(\text{admits}) - \ln(\text{applications})$. Since both acceptances and admits increase by 12 percent following entry into the CA, there is no change in selectivity, or acceptance rates. This is documented in the final column of Table 1, which shows a small and statistically insignificant effect of joining the CA on college acceptance rates. The event study in Figure 10, by contrast, provides some evidence of increasing selectivity following CA adoption. Thus, the evidence with respect to selectivity is mixed.

![Figure 10: Effect of CA Entry on Selectivity](image)

6.2 CA Effect on Distance and Geographic Integration

We next examine whether, using College Board data, the CA has contributed towards the geographic integration over recent decades, as documented above. To investigate this question, we begin by running two-way fixed effects regressions, examining whether the fraction of out-of-state and the fraction of foreign students changes following CA entry. As shown in column 1 of Table 2, the fraction of out-of-state students rises by 1.4 percentage points in the years after joining, relative to the period prior to joining the CA. Likewise, as shown in column 2, the percentage of foreign students increases by about 0.3 percentage points. We next consider these effects in the context of event studies. Figure 11 shows that there is an immediate increase in the fraction of out-of-state enrollment of roughly 1 percentage point following a school joining...
the CA, and this increases to around 2 percent 10 years after joining the CA. The results for percent foreign, as shown in Figure 12, are noisier but are generally consistent with an increase in the fraction of foreign students documented in Table 2.

Table 2: Effect of CA Entry on Student Profiles

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<th>Column (3)</th>
<th>Column (4)</th>
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<td>foreign%</td>
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<td>SAT 75</td>
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All specifications include institution and year FE. In cols 1+2 percentages multiplied by 100. Standard errors clustered by institution (unitid).

Figure 11: Effect of CA Entry on Out-of-State Enrollment
We now examine the effect of the CA on geographic integration using data from IPEDS, which provides state-by-state freshmen enrollment for each institution, but only every other year. In particular, we run a series of analyses similar to those in section 5.2. In Table 3 we show results from our two-way fixed effects specification; results for general time trends in these variables are shown in Appendix Table 4. After joining the CA a university can expect a significant increase in the distance students travel to attend, with column 1 showing an average increase of 30 kilometers, which is about a 10 percent increase (column 2). Restricting to only out-of-state students, the distance increases by 55 kilometers (column 3), an increase of 7 percent for that population (column 4). In addition to out-of-state students traveling further, joining the CA also decreases the percentage of in-state students by about 2.3 increase (column 5) and increases the percentage of foreign students by 0.6 percent (column 6).\(^8\) Generally, the magnitudes of the effects in Table 3 are large. Comparing each coefficient in Table 3 to its counterpart in Appendix Table 4 shows that the effect of joining is about 10 times larger than the yearly trend for distance measures and about 15 times larger for in-state and foreign percentage.

\(^8\)Note that Table 2, which used College Board data, had somewhat smaller coefficients for both in-state and foreign percentage.
Table 3: Effect of Common Application on Geographic Integration

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<td>foreign%</td>
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</tbody>
</table>

Dep var in cols 1 and 2 is distance per student.
Dep var in 3,4 is distance per out-of-state student.
In cols 5+6 shares are multiplied by 100.
All spec include institution FE; std errors clustered by institution.

Next, we consider event study specifications for distance traveled. Figure 13 shows a significant increase in the distance traveled immediately after joining, an effect that continues to increase with time, exceeding 50 kilometers one decade after joining the CA.

Figure 13: Effect of Common Application on Distance Traveled

![Figure 13: Effect of Common Application on Distance Traveled](image)

As noted earlier, the IPEDS survey occurs every two years, and so we subtract one from the “time to entry” variable \((CA_{t+k})\) for universities that join the Common Application in odd years. For example, for a university joining in 2003 we define the 2002 observation as \(t - 2\) and the 2004 observation as \(t\). Universities that join in even years are treated normally; for a university joining in 2004 the 2002 observation is \(t - 2\) and the 2004 observation is \(t\). Therefore each year of the figure is an average of universities \(t + k/2\) years to entry.
6.3 Network Effects and Sorting

If these results with respect to geographic integration are driven by the CA, then this increased out-of-state enrollment should be driven by students applying to other CA institutions. This suggests that institutions that join the CA are likely to see a greater increase in applications from students in states which already have a high number of CA colleges. For example, if New York State has high CA penetration (i.e. many New York schools in the CA), then we might expect that UW-Madison will attract more NY students after joining the CA. We use the IPEDS biennial migration data to examine these ideas and measure CA penetration \( P_{st} \) as the fraction of colleges in source state \( s \) at time \( t \). We then add this penetration measure and an interaction with the CA entry indicator to our two-way fixed effects specification, where the dependent variable is the number of freshmen \( N_{sct} \) from source state \( s \) attending college \( c \) at time \( t \). This interaction term, controlling for the main effects, allows us to test whether enrollment from high CA penetration states increases more when \( c \) joins the CA. The unit of observation is now a college by source state by year, and so we now include college by source state fixed effects. Taken together, our specification is now given by:

\[
\ln(N_{sct}) = \beta_1 \times CA_{ct} + \beta_2 \times P_{st} + \beta_3 CA_{ct} \times P_{st} + \mu_{sc} + \mu_t + \varepsilon_{sct} \quad (15)
\]

In Figure 14 we plot the main effects and the interaction from the above specification.\(^{10}\) Interestingly, the coefficient on CA penetration \( P_{st} \), which can be interpreted as the effect of CA penetration before the college joins the CA, is significantly negative.\(^{11}\) This is consistent with network effects in the sense that non-CA schools can be disadvantaged by students applying to CA schools. The coefficient on the interaction term is large and significantly positive, again suggesting that the increase in enrollment upon joining the CA is coming from students applying to other CA schools. This evidence is again consistent with network effects.

Lastly, in Figure 15 we investigate network effects using our event-study specification. The event study plot shows negative coefficients on source state penetration prior to joining, followed by a sharp jump at the time of entry, and then positive and increasing coefficients thereafter. This type of pattern is consistent with a negative network effect before joining that becomes positive after the school becomes a CA member.

\(^{10}\)Confidence intervals are calculated with standard errors clustered by college

\(^{11}\)The coefficient on the membership main effect is somewhat smaller than the earlier estimate from Table 1, but is not directly comparable without adjusting for the interaction term \((CA_{ct} \times P_{st})\).
Figure 14: Sources of Additional Students

Plot shows coefficients from regression of log enrollment on CA vars. Unit of obs is college year source-state, 1052079 observations. CI calculated with standard errors clustered at college level.

Figure 15: Effects by Source State CA Penetration

Plots coefficients from regression: log enrollment on time-to-entry X CA penetration. Unit of obs is college year source-state, 1052079 observations. CI calculated with standard errors clustered at college level.
6.4 Common Application and Stratification

Our final research question involves whether the CA has contributed towards stratification in higher education. Before doing so, we first document general trends in stratification in this sector. To do so, we again classify schools into five categories: top 50 liberal arts, top 50 private, top 50 public, other private and liberal arts, and other public. As shown in Figure 16, there is a large and increasing gap in SAT/ACT scores at the 75th percentile between selective schools (top 50 liberal arts, top 50 private, and top 50 public), and less selective institutions over our sample period. Given that the CA is disproportionately selective institutions, as we documented above, we next investigate the degree to which the CA has contributed to this widening of the gap between more selective and less selective institutions.

Figure 16: Stratification in Higher Education

As shown in columns 3 and 4 of Table 2, there is a general increase in SAT scores of enrolled freshman following entry into the CA. In particular, SAT scores at the 25th percentile increase by 4 points and SAT scores at the 75th percentile increase by 9 points, although only the latter effect is statistically significant. One interpretation of the difference in effects between the 75th and 25th percentile, in the context of our theoretical extension to heterogeneous student ability, is that the fraction of high ability students is small. In this case, only the top of the distribution
of SAT scores would change following entry into the CA, and the bottom of the distribution would be unaffected since it is composed of low-ability students.

Finally, we examine this effect of CA entry on SAT scores via an event study approach. As shown in Figure 17, the effects for the 25th percentile are noisy and, consistent with the results from the fixed effects regression, the effects are small in magnitude. For the 75th percentile (Figure 18), there is a small increase in SAT scores following CA entry, and the effect rises to over 20 points after 10 years in the CA. These effects should be interpreted with caution, however, as there do appear to be some pre-trends in these figures. Nonetheless, the trends are small in the years just before entry, and, moreover, the 20 point increase in the decade following CA entry is larger than the roughly 10 point increase in the decade prior to CA entry. To conclude, we find mixed evidence regarding the effects of CA entry on SAT scores, with some evidence of increases for the 75th percentile.

Figure 17: SAT 25 and CA Entry
7 Conclusion

Our results suggest that the Common Application has had a significant impact on college admissions. We find that after joining the CA, institutions experience an increase in the number of applications increases, consistent with a reduction in frictions. There is also a significant reduction in yield, consistent with increased student choice sets due to the CA. We also provide evidence of an effect of the CA on geographic integration, with an increase in foreign and out-of-state students. Moreover, these out-of-state students tend to come from other states with significant CA penetration. These patterns are consistent with network effects in the CA. Finally, we provide some evidence that CA entry is associated with an increase in freshmen SAT scores. If so, and given that the CA is disproportionately composed of selective institutions, the CA has contributed towards the rising selectivity gap between more selective and less selective institutions.

References


Caroline Hoxby and Christopher Avery. The missing" one-offs": The hidden supply of high-achieving, low-income students. Brookings Papers on Economic Activity, 2013.


Albert Yung-Hsu Liu, Ronald G Ehrenberg, and Jesenka Mrdjenovic. Diffusion of common application membership and admissions outcomes at american colleges and universities. 2007.


A Appendix

A.1 Conditions for an Interior Solution

Regarding equation 11, the key condition for existence of a solution is that the discriminant must be positive. This amounts to:

\[ f < \frac{C_2^2}{4(C_1 + C_2 - C_{12})} \]  

(16)

This condition requires that the cost of an additional application is sufficiently low to induce a positive fraction of students to apply to both colleges.\(^\text{12}\)

Regarding equation 12, we require the following condition for an interior solution:

\[ QY_1 < \kappa < Q^2(Y_{12} + y_{12}) + Q(1 - Q)(Y_1 + Y_2) \]  

(17)

where \( Q \) is set at its equilibrium value and is thus a function of model parameters. The left hand side of the inequality requires that college capacity is more than sufficient to accommodate accepted students when all students apply to only their first choice, given equilibrium admissions rates. The right hand side requires that the college capacity is not sufficient to accommodate the situation when all students apply to both colleges, given equilibrium admissions rates.

A.2 Proof of Proposition 1

Parts 1) and 2): In Equation 19, it is clear that equilibrium admissions rates are increasing in \( F \). Thus, a marginal reduction in \( F \) leads to a reduction in equilibrium admissions rates. This effect is illustrated in Figure 20 below.

Given that \( Q \) declines under the Common Application, we must next show that \( b \) is decreasing in \( Q \). Taking the derivative of equation 12 with respect to \( Q \), we have:

\[ \frac{db}{dQ} = \frac{-Y_1}{D} - \frac{(\kappa - QY_1)[2Q(Y_{12} + y_{12} - Y_1 - Y_2) + Y_2]}{D^2} \]  

(18)

where the denominator equals \( D = Q^2[Y_{12} + y_{12} - Y_1] + Q(1 - Q)Y_2 \). This denominator is positive since \( Y_{12} + y_{12} > Y_1 \).

\(^{12}\)Indeed, the right hand side value is the maximum value reached by the curve in Figure 19. The condition is saying that the curve must intersect the horizontal line \( f \), which is equivalent to having a positive fraction of students apply to both colleges.
Figure 19: Effects on admissions rates

Substituting back in the definition of $b$, we have that:

$$\frac{db}{dQ} = \frac{-Y_1 - b[2Q(Y_{12} + y_{12} - Y_1 - Y_2) + Y_2]}{D} \quad (19)$$

Re-arranging the numerator, this relationship can be written as follows:

$$\frac{db}{dQ} = \frac{-2bQ(Y_{12} + y_{12} - Y_1) + (bQY_2 - Y_1) - bY_2(1 - Q)}{D} \quad (20)$$

Each of these three terms in the numerator are negative. In particular, the first term is negative since $Y_{12} + y_{12} > Y_1$. The second term is negative since $Y_2 < Y_1$, $b < 1$, and $Q < 1$. Finally, the third term is negative since $Q < 1$ in equilibrium. Since the denominator must be positive for $b$ to be positive, the slope is negative. This change in application rates is illustrated in Figure 15 below.

**Part 3**: Note that the number of admitted students is equal to $Q(1 + b)$, the product of the admissions rate and the number of applications received. Using the closed form solution for $b$, this can be written as:

$$Q(1 + b) = Q + Qb = Q + \frac{\kappa - QY_1}{Q[Y_{12} + y_{12} - Y_1] + (1 - Q)Y_2} \quad (21)$$

Taking the derivative, we have that:
Figure 20: Effects on applications

\[
\frac{dQ(1+b)}{dQ} = 1 - \frac{Y_1}{D} - \frac{\kappa - QY_1}{D^2} [Y_{12} + y_{12} - Y_1 - Y_2] 
\]

where the denominator equals 
\[D = Q[Y_{12} + y_{12} - Y_1] + (1 - Q)Y_2.\]

Using the fact that \(Qb = [\kappa - QY_1]/D\), the slope can be re-written as:

\[
\frac{dQ(1+b)}{dQ} = 1 - \frac{Y_1}{D} - \frac{Qb}{D} [Y_{12} + y_{12} - Y_1 - Y_2] 
\]

This can be re-written as:

\[
\frac{dQ(1+b)}{dQ} = \frac{D - Y_1 - Qb[Y_{12} + y_{12} - Y_1 - Y_2]}{D} 
\]

Since \(D\) is positive, we simply need to show that the numerator is negative. Since the term \(Y_{12} + y_{12} - Y_1 - Y_2\) is negative, the numerator is increasing in \(b\). Thus, to show that it is negative for all \(b\) between 0 and 1, we simply need to show that it is negative when \(b = 1\). In this case, and canceling terms, the numerator can be written as \(Y_2 - Y_1\), which is negative.

**Part 4:** The increase in out-of-state students follows directly from the increase in \(b\) resulting from the reduction in \(F\).

**A.3 Extension to Ability Types**

We consider three colleges \((c)\) and two ability types: low-ability and high-ability. We assume that colleges want to attract as many high ability students as possible and thus admit them
with probability one. Low ability students are then admitted at a lower rate in order to fill any remaining capacity. Given our interest in stratification, we can then simply study the behavior of high ability students. Given that high ability students are admitted with certainty, the model plays out differently in this case. In particular, students will not be indifferent when choosing their application sets, and corner solutions are now relevant for these high ability students. Given these corner solutions, we focus on non-marginal changes in application costs.

We focus here on two cases. In the first case, application costs are sufficiently high that high ability students only apply to their first choice in the absence of the Common Application. For students with the preference order $U_1 > U_2 > U_3$, this requires:

$$C_{12} - C_1 < F$$  \hspace{1cm} (25)

Suppose now that colleges 1 and 2, but not college 3, join the Common Application. Further, suppose that application costs fall sufficiently such that $C_{12} - C_1 > f$, and likewise for students with preference ordering $U_2 > U_1 > U_3$. Then, these two sets of students will apply to both colleges, and students with other preference orderings are unaffected. Since these two sets of students are now more likely to attend college (recall that $Y_{12} + y_{12} > Y_1$), the fraction of high ability students at Common Application colleges increases. The fraction of high ability students at colleges outside of the Common Application is unchanged.

In the second case, suppose that application costs are sufficiently low that high ability students apply to their top two choices, but not their third choice, in the absence of the Common Application. For students with the preference order $U_1 > U_3 > U_2$, not applying to the third college requires:

$$C_{123} - C_{13} < F$$  \hspace{1cm} (26)

where $C_{123}$ represents the value from having a full choice set. Suppose now that colleges 1 and 2, but not college 3, join the Common Application, and application costs fall sufficiently such that $C_{123} - C_{13} > f$, and likewise for all students that have college 1 or 2 as their third choice. Then, all students except those with preference orderings $U_1 > U_2 > U_3$ and $U_2 > U_1 > U_3$ will apply to all three colleges. Thus, there is an increase in applications for colleges 1 and 2 and no increase in applications for college 3. Given that the yield on students accepted to college 3 now falls (resulting from more college 3 applicants also applying to colleges 1 and 2), this implies that colleges 1 and 2 will now draw some high ability students who would have attended college 3 in the absence of the Common Application. Thus, as in the first case, the fraction of high ability students at Common Application colleges increases. The new effect here
is that the fraction of high ability students falls at schools outside of the Common Application.

### A.4 Additional Empirical Results

In Table 4 we calculate the average increase in geographic integration over time for public and private institutions, using the specification \( y_{ct} = \beta_1 \text{years}_t + \beta_2 \text{years}_t \times \text{public}_c + \mu_c + \varepsilon_{ct}. \) In column 1 we find that distance traveled increases by about 3 kilometers per year for private institutions and 1 kilometer per for public institutions, while column 2 specifies average distance in logs and shows that both types of institutions have roughly the same percentage increase over time of 1.4 percent. In columns 3 and 4 we examine the average distance traveled by out-of-state students only to separate the effects of a change in the percentage of out-of-state students from a change in the geographic composition of the out-of-state students. Interestingly, the results show that while out-of-state students at private institutions are traveling further each year, there is essentially no increase in distance for out-of-state students at public institutions (the interaction effect is the same magnitude as the main effect). This implies that the increasing distance traveled by public university students comes entirely from an increase in the out-of-state percentage, which increases at about 0.15 percentage points each year for both types of institutions (the in-state percentage is multiplied by 100 in column 5). Lastly, in column 6 we show that the percentage of total enrollment from foreign students (multiplied by 100) increases by about 0.04 percentage points each year for private institutions and 0.01 percentage points for public institutions.
### Table 4: Geographic Integration by Institution Type

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Dep var in cols 1 and 2 is distance per student.
Dep var in 3,4 is distance per out-of-state student.
In cols 5+6 shares are multiplied by 100.
All spec include institution FE; std errors clustered by institution.

As a further analysis of the effect of joining CA on distance traveled, we now consider the change in the entire distribution of a college’s enrollees over distance. To do so, we restrict our sample to only those institutions who joined the common app and who have migration data directly three or fours years before and three or four years after joining, depending on whether the institution joined in an odd or even year. We then sum the enrollees across all universities in each period (pre,post) and calculate the percentage coming from each state-to-state distance. This allows us to calculate two cumulative distribution functions (CDF), where each bin of the CDF represents a given state-to-state distance and we are calculating the percentage of students traveling that distance to all universities in a period. We then plot the difference between the before and after CDF in Figure 21. The largest difference occurs at zero, indicating that most of the effect comes from a 3 percentage point decrease in the in-state percentage. The slope of this differenced CDF increases sharply and approaches zero, so that a distance of 1200 kilometers the change is less than 1 percent, and then flattens. This shape suggests that CA entry increases the distance traveled by enrollees by mostly increasing the number of enrollees from nearby states.

---

13 We truncate the graph at 4000km since the share of students coming from a greater distance is very small in both periods.
Figure 21: Effect of CA Entry on Enrollment Share Change by Distance

Enrollment share change: enrollment share before CA - enrollment share after.
Before CA is 3 or 4 years before join year; after CA defined analogously.
Sample has 265 institutions.
Distance is between state centroids, in-state distance is defined as zero.
Graph smoothed with median-spline method, 50 bands.