

Reducing Frictions in College Admissions: Evidence from the Common Application[†]

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College admissions in the United States are decentralized, creating frictions that limit student choice. We study the Common Application (CA) platform, under which students submit a single application to member schools, potentially reducing frictions and increasing student choice. The CA increases the number of applications received by schools, reflecting a reduction in frictions, and reduces the yield on accepted students, reflecting increased choice. The CA increases out-of-state enrollment, especially from other CA states, consistent with network effects. Entry into the CA changes the composition of students, with evidence of more racial diversity and more high-income students and imprecise evidence of increases in SAT scores. (JEL I23, I28)

College admissions in the United States have traditionally followed a decentralized process, with students completing separate applications for each school and colleges independently making admissions offers.¹ There are advantages and disadvantages to the frictions associated with this decentralized system. By limiting the number of schools to which students apply, decentralized systems might ultimately limit the degree of student choice and create a less integrated and less competitive market. At the same time, a more centralized system might increase stratification. In particular, with heterogeneous groups of students and institutions, students with high test scores might be more likely to apply to and ultimately attend elite out-of-state institutions—rather than local institutions—under a more centralized system, and a similar logic applies to sorting according to any student attribute that is valued by institutions. In this paper, we investigate a movement toward greater centralization created by the Common Application (CA), a consortium of colleges that accept a single application. The CA began in 1975 with 15 liberal arts colleges but grew rapidly thereafter, with a significant acceleration of membership starting around 2000 and roughly 700 members by 2016 (Figure 1). Member institutions

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¹These time-based frictions are in addition to any information frictions facing students as a result of decentralized college admissions.

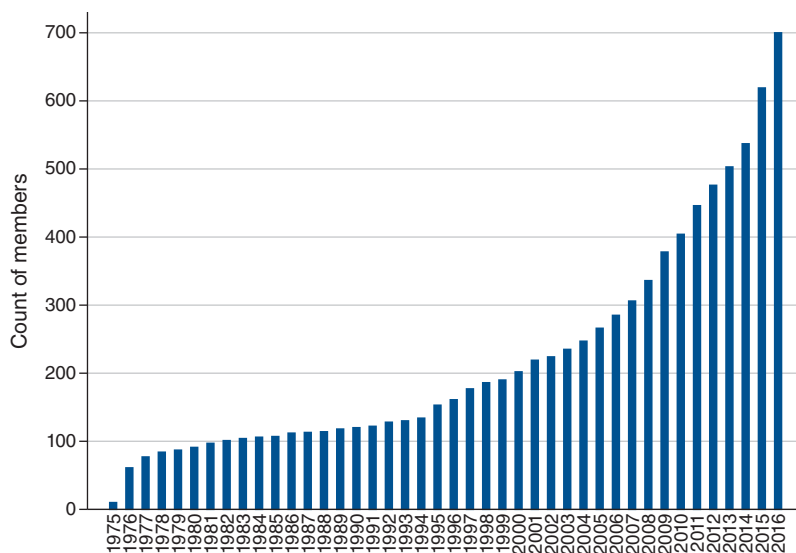


FIGURE 1. COMMON APPLICATION MEMBERSHIP BY YEAR

Notes: Figure plots total count of schools using the CA in each year. School membership is based on most recent entry year, provided by the CA organization.

are disproportionately selective, as documented below, with nearly all elite private universities currently members, and with potential implications for stratification.

In this paper, we ask a series of research questions. Has the CA reduced frictions, resulting in more college applications at member institutions and increased student choice? Has the CA led to a more geographically integrated market, with more students attending CA institutions far from home? If so, by increasing student choice and integrating the market geographically, has the CA contributed to stratification—a widening of the selectivity gap between more selective and less selective institutions? Related to this, has the CA altered racial and socioeconomic diversity in higher education?

We address these questions using panel data from the College Board covering the period of 1990–2016. We estimate fixed effects regression models, comparing outcomes for schools before and after joining the CA, and provide event studies, investigating the timing of any effects associated with entry into the CA. Overall, we find that the CA increases applications at member institutions, consistent with a reduction in frictions, and reduces yield, consistent with enhanced student choice. Schools respond to this reduced yield by admitting more students. Turning to the composition of students, we find that the CA has accelerated geographic integration: entry of an institution into the CA is associated with an increase in the fraction of out-of-state students, especially from other states with significant CA penetration, consistent with network effects. Finally, we investigate three measures of student heterogeneity. We provide some evidence that entry into the CA is associated with an increase in SAT scores. While these results are imprecise, we provide stronger evidence that CA adoption increases the fraction of non-White students and reduces the fraction of low-income students. Given that, prior to joining, CA colleges tend to

have fewer non-White students, fewer low-income students, and higher test scores, the CA has increased stratification according to income and test scores but has reduced stratification according to race.

The most closely related paper in the literature is Liu, Ehrenberg, and Mrdjenovic (2007), who also use panel data from the College Board to study how CA membership affects admissions outcomes and the composition of enrollees at public institutions over the period 1975–2005. Our paper focuses on a more recent time period, 1990–2016, allowing us to study both the rapid growth in the platform in recent years and the role of private institutions, which were first allowed to join in 2002.^{2,3} In addition, we develop new identification strategies focused on addressing pre-trends.⁴ Two other studies have examined the impact of the CA on college admissions. Smith (2013) studies the effect of the number of applications on enrollment probabilities using variation induced by adoption of the CA by nearby colleges. He finds that increasing the number of applications, when induced by the CA, significantly increases enrollment probabilities. Smith, Hurwitz, and Howell (2015) analyze various frictions in the application process, finding some evidence that the CA increases applications. Fees and essay requirements, by contrast, decrease applications. Our paper addresses different research questions, and, as such, the effect of the CA on college admissions outcomes remains up for debate.

More broadly, our paper relates to four other literatures on college admissions. The first examines specific policies that make it easier to apply to college.⁵ In this paper, we focus on a different change in the college admissions process, namely, a reduction in the complexity and time associated with applying to multiple colleges. A second literature focuses on information frictions associated with decentralized admissions.⁶ Given that the CA reduces the time cost associated with submitting applications to multiple CA schools, we interpret the CA as reducing time-based

²As noted above, the CA grew from under 300 members in 2005 to roughly 700 members in 2016.

³Perhaps due to these changes in the CA over time, our effects regarding admissions outcomes tend to be larger in magnitude than those in Liu, Ehrenberg, and Mrdjenovic (2007). In particular, we find that applications rise 12 percent and that yield falls 8–9 percent, whereas Liu, Ehrenberg, and Mrdjenovic (2007) find that applications rise 6 percent and that yield falls by 3 percent. We also find different results for some outcomes related to student composition, with some evidence of increases in SAT scores and reductions in the fraction of low-income students. An additional contribution involves our focus on geographic integration. Specifically, we provide novel findings documenting robust increases in out-of-state enrollment, and we also examine the role of network effects in terms of out-of-state enrollment increases being driven by students from source states with significant CA penetration. This contributes to a literature on trends in geographic integration in higher education, as described below.

⁴In particular, we present event study figures, allowing readers to see both pre-trends and the dynamic effects of CA adoption, and also provide results from an identification strategy that compares outcomes for new CA members to outcomes for schools that will join the CA in the next few years. We argue that joiners are more comparable to this comparison group than to broader comparison groups that include never-joiners and schools that join in the more distant future.

⁵Bettinger et al. (2012) show that assistance filling out the FAFSA increases aid receipt, college attendance, and persistence. Bond et al. (2018) document that the opening or closing of nearby SAT testing centers changes college attendance and graduation. Goodman, Gurantz, and Smith (2018) document that many low-income students do not retake the SAT, even though retakes are both free and associated with increases in test scores.

⁶Hoxby and Avery (2013) document that many low-income but high-ability students do not apply to selective colleges, despite generous financial aid. In an experiment, Hoxby and Turner (2014) and Hoxby and Turner (2015) provided these types of students with information about college admissions and financial aid, increasing applications to and attendance at selective institutions. Gurantz et al. (2019) provided information about selective colleges to low-income and middle-income students but find little evidence of changes in college attendance patterns. Bird et al. (2019) conducted a field experiment using the CA platform, finding that information about financial aid does not increase college attendance.

frictions associated with applications. It is also possible that the CA provides information to applicants through the platform. A third literature has examined how college admissions and, in particular, the recent increase in the number of applications per student have changed both university and student strategic behavior.⁷ Our paper contributes to this literature by examining the contribution of the CA to these recent trends. Finally, an additional literature has examined the causes and consequences of recent trends toward geographic integration in higher education.⁸ We identify the CA as a new potential cause of this trend and examine its consequences for higher education.

The paper proceeds as follows: after providing some background information on the CA, we present a theoretical model of the college admissions process and generate our key hypotheses. We then describe the data, the empirical approach, and our key empirical results. The final section concludes.

I. Background

The CA was founded by 15 liberal arts colleges in the Northeast but has since expanded to a wide range of public and private institutions, especially more selective institutions. As shown in Figure 2, membership among the top 50 liberal arts colleges was already very high—over 80 percent in 1990, the starting point of our analysis—and was universal among this group by the late 1990s. During our sample period, membership among the top 50 private institutions increased rapidly, from under 40 percent in 1990 to roughly 90 percent by 2016. Taken together, the CA currently receives approximately 4 million applications from 1 million students annually.⁹

Membership among less selective liberal arts colleges and other private institutions also increased during our sample period but remained below 50 percent in 2016. The CA was originally closed to public institutions, but that ban was lifted in 2002, leading to a rapid increase in membership among the top 50 public institutions. Less selective public institutions, by contrast, joined at a slower rate, with membership rates still below 20 percent by the end of our sample period.

In addition to this rapid entry overall, the CA has also become more diverse from a geographic perspective. That is, the CA started in the Northeast but is now accepted by colleges in many different states. Figure 3 plots the locations of CA members in 1986 and 2014, documenting a much wider geographic distribution in

⁷Bound, Hershbein, and Long (2009) document increases over time in the number of students applying to college, increases in applications per student, and reductions in acceptance rates at selective institutions. Blair and Smetters (2019) investigate why elite colleges haven't responded to this increase in applications by expanding capacity, arguing that colleges compete on prestige. Avery and Levin (2010) document that early applicants are more likely to be admitted and argue that this finding is consistent with an early application serving as a signal of student enthusiasm. Avery et al. (2013) argue that standard methods of ranking colleges provide incentives for institutions to manipulate admissions to reduce acceptance rates and to increase yield.

⁸Historically, the US market for higher education was highly localized, with most students attending universities close to their residences (Hoxby 2000). Starting in the 1940s, the market for higher education became more national, leading to both higher tuition and greater student sorting (Hoxby 1997, 2000, 2009). Despite this shift, the US market may still be considered local in nature, with roughly 80 percent of students attending in-state institutions, and Knight and Schiff (2019) and Cohodes and Goodman (2014) identify financial incentives, in the form of in-state tuition discounts and financial aid for in-state institutions, as contributing factors.

⁹From <https://www.commonapp.org/about-us>, accessed April 2018.

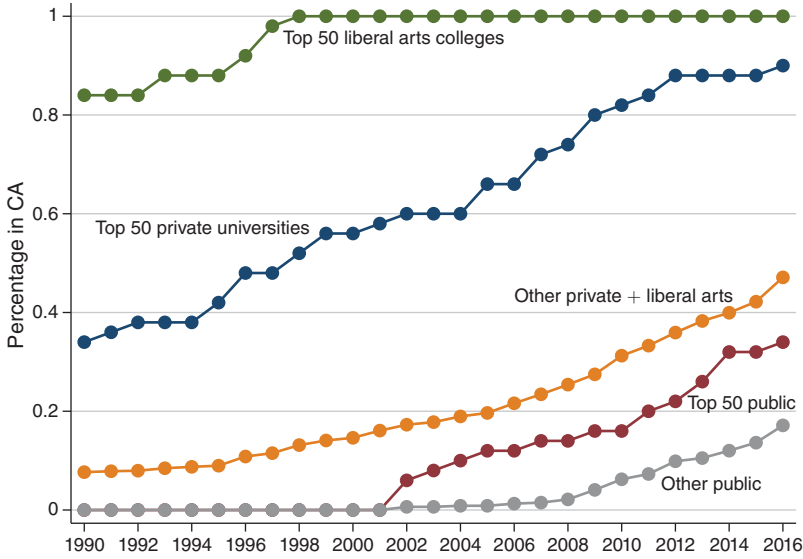


FIGURE 2. COMMON APPLICATION MEMBERSHIP RATES BY YEAR AND TYPE

Notes: Figure plots percentage of schools in each category using the Common Application. Categorization of schools comes from the data appendix of Bound, Lovenheim, and Turner (2010).

Panel A. CA in 1986

Panel B. CA in 2014

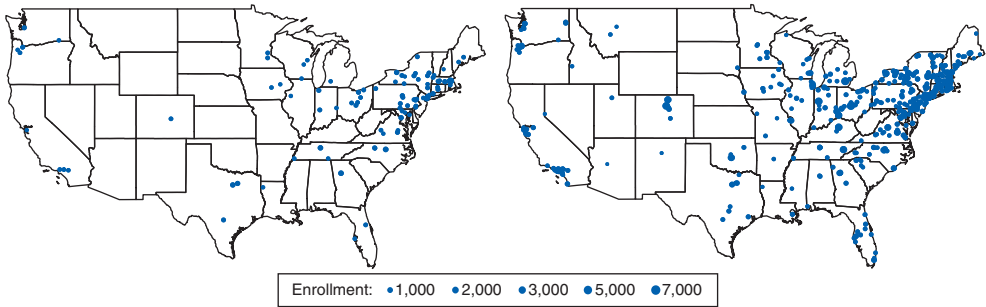


FIGURE 3. COMMON APPLICATION MEMBERSHIP BY STATE

Note: Each circle shows the location of a school using the Common Application. The size of the circle depends on total enrollment in that year.

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 present, it is natural that the CA may have led to significant changes in college admissions.

II. Theoretical Model

Following decentralized college admissions, our model has three stages: first, students decide which colleges to apply to; second, colleges set admissions rates; and

third, given admissions offers, students decide which college to attend. There are two colleges: $c = 1$ and $c = 2$. Students pay a fee for the first application (F) and a potentially lower fee ($f \leq F$) when applying to a second college. The CA can be interpreted as a reduction in f since the application developed for the first college can also be used for the second college, and we examine how the CA changes student application activity and college admissions rates. In extensions of the model, we consider more than two colleges, college preferences over heterogeneous students, and two types of application costs: fees and time.

Each college has a fixed capacity, with total capacity across the two colleges serving a fraction $\kappa < 1$ of the student population. Each college sets an admissions rate, given the number of applicants, in order to satisfy their capacity $\kappa/2$. In our baseline model, colleges do not have preferences over students, simply setting an admissions probability Q_c that applies to all applicants. In extensions below, we consider more realistic college objective functions in which admissions decisions reflect college preferences over student characteristics, such as test scores and race.

Students receive a payoff $V_c = U_c + \epsilon_c$ from attending college c .¹⁰ The first term (U_c) represents pre-application information and might include residency status, reflecting the fact that over 80 percent of US students attend in-state institutions.¹¹ The second term (ϵ_c)—assumed to be distributed type-1 extreme value—represents post-application information, is revealed after applying but before choosing a college, and could reflect, for example, scholarship and financial aid offers or impressions from campus visits. There are two types of students: one-half prefer college 1 over college 2 ex ante, knowing pre-application information but not post-application information, and one-half prefer college 2 over college 1.¹² Given all of this, and under symmetric admission rates ($Q_1 = Q_2 = Q$), a student preferring college 1 ex ante will find it optimal to apply to both colleges over only applying to their first choice under the following condition:

$$(1) \quad \underbrace{Q^2(C_{12} - C_1)}_{\text{option-value}} + \underbrace{(1 - Q)QC_2}_{\text{safety-value}} \geq f,$$

where C_{12} is the expected value of having a choice set of both colleges, prior to knowing post-application information, and C_1 and C_2 are the corresponding expected values of having a choice set of only college 1 or college 2.¹³ As shown on the left-hand side of the equation, there are two benefits to applying to a second college. According to the option value, the ex ante second choice might be

¹⁰Not attending college is also an option, with a payoff normalized to zero. This outside option could also be interpreted as attendance at non-selective institutions, such as community colleges, without an application process.

¹¹Source: https://nces.ed.gov/programs/digest/d19/tables/dt19_309.10.asp?current=yes, accessed August 7, 2020. This preference for in-state institutions could be due to either a preference for proximity to home or lower in-state tuition at public institutions, an issue examined in Knight and Schiff (2019).

¹²We assume symmetry in the expected utility gains from attending the first-choice college. That is, $U_1 - U_2 = \delta > 0$ for the first type and $U_2 - U_1 = \delta > 0$ for the second type. This assumption, along with the assumption that one-half of students prefer college 1 over college 2, simplifies the analysis by allowing us to focus on an equilibrium with symmetric admissions rates and in which both types of students apply to both colleges at a symmetric rate.

¹³Given the type-1 extreme value assumption, these are equal to $C_{12} = \ln[\exp(U_1) + \exp(U_2) + 1]$, $C_1 = \ln[\exp(U_1) + 1]$, and $C_2 = \ln[\exp(U_2) + 1]$, with $C_{12} > C_1 > C_2$.

preferred ex post, following the realization of the post-application information. This is relevant when students are accepted to both colleges, an event that occurs with probability Q^2 . According to the safety value, students might be accepted to only their second choice, an event that occurs with probability $(1 - Q)Q$. The right-hand side is the cost of applying to a second college. If this cost is sufficiently high, students prefer to apply to only one college. In equilibrium, equation (1) is binding and students are indifferent between applying to only one college and applying to both, with a symmetric fraction of students b applying to both colleges and a fraction $1 - b$ applying to only their first-choice college.

Given application behavior, colleges set admissions rates in order to equate the number of student acceptances of admissions offers to university capacity. For college 1, for example, total student acceptances equals the yield on first-choice students who are admitted to college 1 plus the yield on second-choice students who both apply to and are admitted to college 1. This must then equal capacity, as expressed in the college capacity condition below:

$$(2) \quad 0.5Q \underbrace{[(1 - b) Y_1 + bQ Y_{12} + b(1 - Q) Y_1]}_{\text{yield on first-choice}} + 0.5Qb \underbrace{[Q y_{12} + (1 - Q) Y_2]}_{\text{yield second-choice}} = \kappa/2.$$

Among 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} at college 1, and a fraction $1 - Q$ are denied admission to their second choice, with yield for college 1 thus equal to Y_1 . The second term represents yield on second-choice students, with a fraction b applying to both colleges. Among these, a fraction Q are also admitted to their first choice and yield equals y_{12} . The remaining fraction $(1 - Q)$ are not admitted to their first choice and yield on these students equals Y_2 .¹⁴

In equilibrium, universities set an admissions rate Q^* , and a fraction of students b^* apply to both colleges, as determined by the student indifference condition (equation (1) when binding) and the college capacity condition (equation (2)), with closed-form solutions in the online Appendix.¹⁵ As shown in Figure 4, the horizontal line at Q^* plots the binding student indifference condition prior to the CA. This is the admissions rate at which students are indifferent between applying to one and two schools. If the admissions rate were less than Q^* , then all students would apply to only one school ($b = 0$), and if the admissions rate were higher than Q^* , then all students would apply to both schools ($b = 1$). Against this condition, we plot the college capacity condition, which shows that colleges must reduce their admissions

¹⁴ Given the type-1 extreme value assumption, these yields are equal to $Y_1 = \exp(U_1)/[1 + \exp(U_1)]$, $Y_2 = \exp(U_2)/[1 + \exp(U_2)]$, $Y_{12} = \exp(U_1)/[1 + \exp(U_1) + \exp(U_2)]$, and $y_{12} = \exp(U_2)/[1 + \exp(U_1) + \exp(U_2)]$.

¹⁵ In the online Appendix, we also develop a set of conditions guaranteeing the existence of a unique interior equilibrium.

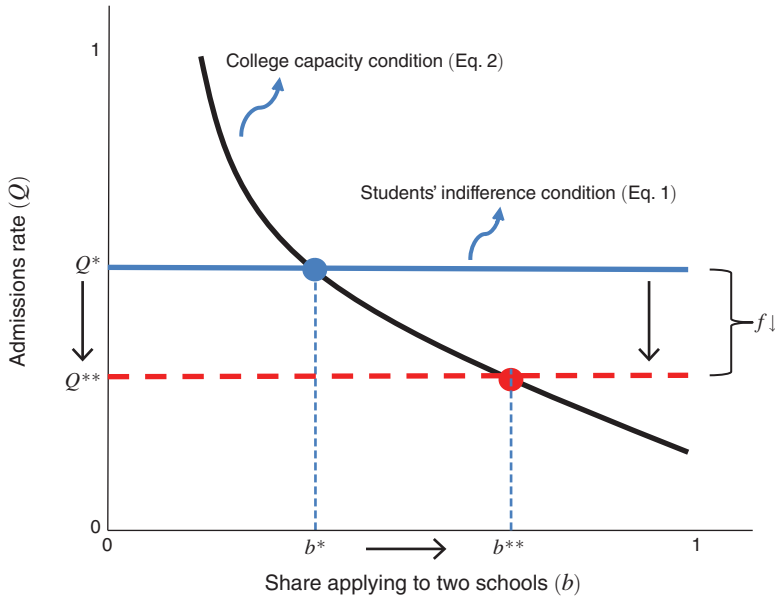


FIGURE 4. THEORETICAL EFFECTS OF COMMON APPLICATION

Notes: Initial equilibrium is at (b^*, Q^*) , in which a fraction of students apply to both colleges and enrollment is exactly equal to each college’s fixed capacity. After the second university joins the Common Application, the cost of applying to a second school decreases from F to f . As a result, the share of students applying to both institutions increases and universities must reduce the admissions rate so that enrollment does not exceed capacity. In the new equilibrium (b^{**}, Q^{**}) , the share applying to both universities is higher and admissions rates are lower.

rate as the share of students applying to both schools increases so that enrollment does not exceed capacity. The intersection of these conditions (b^*, Q^*) represents an interior equilibrium at which a fraction of students apply to both colleges and the number of students accepting each college’s admissions offers exactly equals their fixed capacity.

Under the CA, which reduces f , students are no longer indifferent between applying to one institution and applying to both institutions, and the fraction applying to both increases accordingly, from b^* to b^{**} . Given this, admissions rates fall in order to satisfy capacity, from Q^* to Q^{**} . Despite the reduction in admissions rates, universities make more admissions offers in total in order to satisfy their capacities. This is driven by the reduction in yield on admitted students, who tend to have larger choice sets under the CA.¹⁶ Finally, interpreting first-choice colleges as in-state and second-choice colleges as out-of-state, as described above, the CA leads to geographic integration, resulting from more students applying to out-of-state institutions. These results are summarized below, with a proof in the online Appendix.

PROPOSITION: Consider the introduction of the CA, with a marginal reduction in the cost of applying to a second college. There are four effects: (i) application

¹⁶Yield is defined as the probability that a student accepts an admissions offer.

activity increases, (ii) admissions rates fall, (iii) yield falls and, despite increasing selectivity, universities accept a larger number of applicants, and (iv) students are more likely to attend out-of-state institutions.

A. Extensions and Welfare

The online Appendix develops three model extensions, all of which have three colleges, with only two in the CA. There is now also state 3, in which college 3 is located. The first extension considers network effects. The CA, with colleges 1 and 2 as members, increases the number of students applying to both colleges 1 and 2 but reduces second application activity for students whose *ex ante* first choice is college 3, which is outside of the CA. Given this, the CA leads to network effects, with more student migration between states connected by the CA and less migration between states not connected by the CA.¹⁷

The second extension considers heterogeneous students with low and high test scores. Colleges want to attract students with high scores and admit them with probability one. Students with low scores are then admitted at an admissions rate that fills colleges' remaining capacity. In equilibrium, students with high scores disproportionately attend CA schools, and students with low scores disproportionately attend schools outside of the CA, resulting from increased application activity among students with high scores at CA schools. Thus, the CA increases stratification, with high-test-score students disproportionately attending CA schools. This extension can handle any student attribute that is valued by colleges. If colleges value racial diversity, they can enroll a higher fraction of non-White students via an increase in the size of this applicant pool upon joining the CA. Given these predictions, our empirical analysis investigates the effect of joining the CA on both test scores and students' races.

The third extension considers student income. There are now two types of application costs, financial and time. The financial cost, which includes the application fee, is unchanged under the CA. The time cost of applying to a second CA college, by contrast, falls under the CA. If financial costs are more salient than time costs for low-income students relative to high-income students, then low-income students will be less responsive to the CA in terms of applying to multiple colleges.¹⁸ In this case, CA schools might disproportionately attract high-income applicants and thus ultimately enroll more high-income students relative to schools not in the CA. We investigate this issue below with data on Pell Grants.

¹⁷ While we have not formally extended the model beyond three colleges, it is natural to conjecture that network effects might intensify as the size of the network grows beyond two. See the online Appendix for more details.

¹⁸ The salience of financial costs for low-income students could be driven by credit constraints, for example. That is, if low-income students have a fixed budget for college applications, then a reduction in time costs will not induce additional applications. In a series of papers, Hoxby and Avery (2013), Hoxby and Turner (2014), and Hoxby and Turner (2015) argue that application fees deter applications from low-income students, who are often not aware of fee waivers. In an experiment, students provided fee waivers substantially increase their applications to selective colleges. Along these lines, Pallais (2015) shows that an increase in the number of free ACT score reports, which cost only \$6 once the free reports have been sent, leads to a large increase in scores sent by ACT takers, and low-income ACT takers subsequently attended more selective colleges.

Does the CA increase student welfare? While the CA reduces frictions and increases student choice, it does not necessarily increase student welfare. In fact, the CA strictly reduces welfare in our baseline model.¹⁹ Since the cost of applying to one college is unchanged and the probability of admission falls, the value of applying to only one college declines under the CA. Given that in equilibrium students are indifferent between submitting one and two applications, all students are worse off *ex ante*. In our extensions with heterogeneous students, there are winners and losers under the CA. Students with high test scores are strictly better off, since they are guaranteed admission and have a larger choice set under the CA. Students with low test scores, by contrast, might be worse off due to CA colleges becoming more selective. Likewise, low-income students are strictly worse off while high-income students might be better off.

B. Summary

In our model, the CA increases applications, reduces admissions rates, reduces yield, increases the number of admitted students, and increases out-of-state attendance, especially from other CA states. If schools have preferences for students with high test scores and for racial diversity, then schools joining the CA will have more enrollees with these characteristics. The reduction in time costs could also increase enrollment from high-income students. The CA strictly reduces *ex ante* welfare in our baseline model but can lead to winners and losers under our extensions.

III. Empirical Analysis

To test the model predictions, we next consider how admissions outcomes and student demographics change when an institution joins the CA. We first describe the data and our empirical approach. We then present the key empirical results with respect to aggregate admissions outcomes, including applications, yield, admits, and selectivity. After addressing issues of geographic integration, we then turn to the question of whether and how the CA might change the composition of students.

A. Data

Our primary data source is the College Board's Annual Survey of Colleges, covering the years 1990–2016. These data include information on both admissions outcomes (the number of applications, admits, and subsequent freshman enrollment) and demographics of the entering student body (fraction out-of-state, SAT scores at the twenty-fifth and seventy-fifth percent levels, and percent non-White). We focus on four-year institutions, both public and private, and the unit of observation is an institution-year pair. Summary statistics are provided in online Appendix Table B1. As shown, institutions receive 4,462 applications on average, admit 2,672 students, and enroll 931 students. Acceptance rates average 70 percent across institutions and

¹⁹Note that our model does not incorporate several possible benefits of the CA, such as a reduction in information frictions and an increase in overall college attendance.

years, and yield—the fraction of admissions offers accepted by students—averages 41 percent. The fraction of out-of-state enrollment averages 31 percent, and the fraction of non-White students in the freshmen class averages 32 percent. The College Board panel is unbalanced, since institutions do not respond to the survey every year. The median institution is included in 24 out of 27 surveys, and two-thirds of institutions are included in at least 21 surveys.

To examine the effects of the CA on admissions and enrollment outcomes, these data are combined with the year in which each university became a member of the CA.²⁰ We also use two other data sources. First, we downloaded data on the number of students receiving Pell Grants by institution and year from the Department of Education.²¹ Second, the Integrated Postsecondary Education Data System (IPEDS) has information on state-to-state student migration conducted biennially from 1986 to 2014, and we use these data to study network effects. In this case, the unit of observation is an institution by source state by year.

B. Identification Strategy

We use two estimating equations in most of our analysis: a regression model with a constant coefficient and an event study specification. The regression model relates an outcome y_{ct} (e.g., applications) to an indicator for CA membership in year t (CA_t) as follows:

$$(3) \quad \ln(y_{ct}) = \beta CA_{ct} + \mu_c + \mu_t + \epsilon_{ct}$$

where c indexes colleges, μ_c is a college fixed effect, and μ_t is a year fixed effect. Then, given the log specification, the parameter β captures the percent change in outcomes when joining the CA, after controlling for time effects and university effects.

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

$$(4) \quad \ln(y_{ct}) = \underbrace{\sum_{k=-K}^{-1} \beta_{t+k} \mathbf{1}(t - J_c = k)}_{\text{pre-entry}} + \underbrace{\sum_{k=0}^K \beta_{t+k} \mathbf{1}(t - J_c = k)}_{\text{post-entry}} + \mu_c + \mu_t + \epsilon_{ct}$$

where J_c is the year college c joined the Common App and $\mathbf{1}(t - J_c = k)$ indicates that college c joined the CA k years ago (or will join in the future, when k is negative). We normalize β_{t-1} to zero and, hence, the key parameter β_{t+k} captures the effect of joining the CA at time t on outcomes at time $t + k$ relative to outcomes at time $t - 1$.

²⁰The entry year for current CA members was provided to us by the Common Application organization. The organization could not provide us with entry information for previous members and only provided us with the most recent entry year for schools that left and then rejoined. They noted that it is uncommon for schools to leave the CA and even rarer for schools to then rejoin at a later time.

²¹These data were downloaded from <https://www2.ed.gov/finaid/prof/resources/data/pell-institution.html> (accessed March 1, 2020).

A key threat to identification in our analysis is that joiners might have different pre-trends relative to the comparison group, which includes schools that never join during our sample period and schools that will join in the future but before the end of our sample period. To address this concern, we also implement an alternative identification strategy in which, similarly to Deshpande and Li (2019), we compare outcomes for joiners to outcomes for colleges that will join the CA in the near future.²² Under this approach, only colleges that eventually join the CA are included in the estimation, and thus identification relies only on variation in the join year within a small observation window. More specifically, for each school that joins we construct a comparison group that includes colleges that will join three to five years in the future. To ensure that the comparison group does not join during the relevant window, we analyze outcomes over a eight-year window including the five years before joining, the join year, and the two years after joining. For example, for a school joining in 2000, the comparison group includes colleges that join in 2003, 2004, and 2005, and we analyze outcomes over the period 1995–2002. We present both regression estimates with a single coefficient as well as event studies based upon this restricted comparison group of schools that will join in the near future. More details are provided in online Appendix Section B.5.

The idea behind this approach is that schools that join in the near future are more comparable than schools joining in the more distant future and schools that never join the CA during our sample period. The event study plots presented in the following sections test this idea directly and show that joiners and future joiners do indeed have similar pre-join time trends. To provide additional evidence on the comparability of joiners and joiners in the near future, online Appendix Figure B8 compares the pre-join levels of each variable between joiners and the comparison group separately for each identification strategy.²³ The first set of bars in each graph compares schools that join the CA during our sample period to schools that never join the CA using the 1990 values of each variable, and thus approximates pretreatment differences in our baseline approach. The second set of bars corresponds to the future-joiners approach and compares joiners to their comparison group. In nearly every graph, the second set of bars are closer to each other than the first set of bars. This provides evidence of the comparability of joiners and joiners in the near future.

Comparing the two approaches, our baseline approach has two key advantages. First, it is based upon a larger sample size, both in terms of the number of institutions and the time span analyzed per institution. Second, our baseline strategy is better able to detect any long-run effects of joining the CA, given that the analysis focuses on a longer time span. The key advantage of the future-joiners strategy is that the comparison group is more similar. In addition, the comparison group in this approach is fixed, whereas the comparison group in our baseline analysis changes over time for each school that joins during our sample period.

²²Deshpande and Li (2019) estimate the effects of Social Security Administration field office closings on local disability recipients by comparing areas where a field office closed to areas where an office closed several years later.

²³Note that due to the inclusion of college fixed effects, similar levels are not required for identification so long as trends are similar.

TABLE 1—CA ENTRY AND ADMISSIONS OUTCOMES

	log applications (1)	log yield (2)	log admits (3)	log selectivity (4)
CA member	0.1204 (0.0201)	-0.0868 (0.0130)	0.1138 (0.0204)	-0.0067 (0.0110)
Observations	34,519	34,360	34,556	34,468
Clusters	1,632	1,631	1,632	1,632

Note: Results from constant coefficient specification (equation (3)) on full sample. All specifications include institution and year fixed effects. Standard errors clustered by institution in parentheses.

TABLE 2—CA ENTRY AND ADMISSIONS OUTCOMES: FUTURE JOINERS COMPARISON

	log applications (1)	log yield (2)	log admits (3)	log selectivity (4)
CA member	0.1097 (0.0150)	-0.0735 (0.0115)	0.0818 (0.0137)	-0.0276 (0.0077)
Observations	12,182	12,134	12,184	12,179
Clusters	488	488	488	488

Notes: Results from constant coefficient specification (equation (3)), restricting comparison group to future joiners. All specifications include institution and year fixed effects and an indicator for joiner versus comparison group (see online Appendix for details). Standard errors clustered by institution in parentheses.

C. Admissions Outcomes

We begin our investigation of the effect of joining the CA by examining the number of applications using the College Board data.²⁴ As shown in the first column of Table 1, we find that applications are 12 percent higher after a college joins the CA relative to the period before they joined the CA. This economically and statistically significant result is consistent with the CA reducing frictions in college admissions via a reduction in the cost of applying to multiple universities that use the CA. Results are similar when restricting the comparison group to future joiners, as shown in the first column of Table 2.

To investigate the role of pre-trends and to consider any dynamic effects of joining the CA, we next present results from the corresponding event study specification.²⁵ As shown in Figure 5, panel A, which includes 95 percent confidence interval bars, there is a slight downward trend in applications just before a school joins the CA. After joining the CA, by contrast, there is a discontinuous 10 percent increase in the number of applications received. Moreover, the effect grows over time, rising

²⁴ Standard errors are clustered at the institution level.

²⁵ The left-hand panel of all event study plots shows results from estimating equation (4) using our full sample, including coefficients β_{t+k} for a few schools as early as 27 years before joining or as late as 40 years after joining. Schools that never join the CA are also included in the sample. In the plots we show a window of eight pre-join years and nine post-join years, which captures a large percentage of our pre- and post-join observations. As noted above, we normalize the coefficient one year before joining to zero ($\beta_{t-1} = 0$).

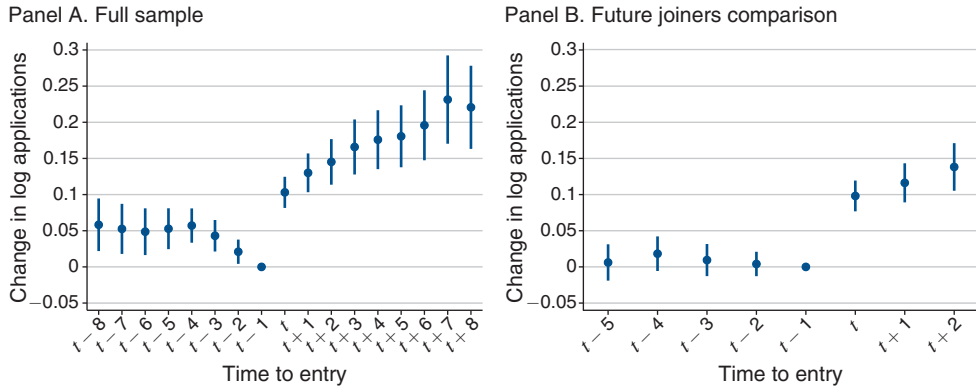


FIGURE 5. CA ENTRY AND APPLICATIONS

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

to roughly 23 percent after eight years in the CA. There are at least two possible reasons why the effects might increase over time. First, the effect 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 relative to the early days of the CA, when applications were still submitted on paper. Second, there could be network effects, with larger effects associated with joining the CA as the number of other CA members increases over time. We investigate the possibility of network effects in more detail below. When restricting the comparison group to future joiners as shown in Figure 5, panel B, there are no pre-trends in the number of applications received. Applications again spike by 10 percent in the join year, with some evidence, again, that the effect of joining the CA grows over time, reaching 15 percent just two years after schools join the CA.

We next investigate whether entry into the CA has led to a decrease in yield. As shown in column 2 of Table 1, there is a 9 percent reduction in yield after a college joins the CA relative to the period before they joined the CA, and this effect is statistically significant at conventional levels. In the context of our model, this finding is consistent with the CA increasing student choice via a reduction in frictions associated with submitting college applications to multiple CA schools. Results are similar when restricting the comparison group to future joiners, as shown in column 2 of Table 2. Figure 6 shows the event study specifications for yield. As shown in Figure 6, panel A, there is an immediate and discontinuous drop after a college joins the CA, with yield falling by roughly 7 percent. This effect again becomes more pronounced over time, with a 13 percent reduction in yield eight years after joining the CA. This dynamic effect could, again, be driven by either the CA becoming more powerful over time or by network effects associated with an increase in the number of CA members. Finally, as shown in Figure 6, panel B, results are similar when restricting the comparison group to future joiners, with an immediate 7 percent reduction in the join year and a 10 percent reduction just two years after joining.

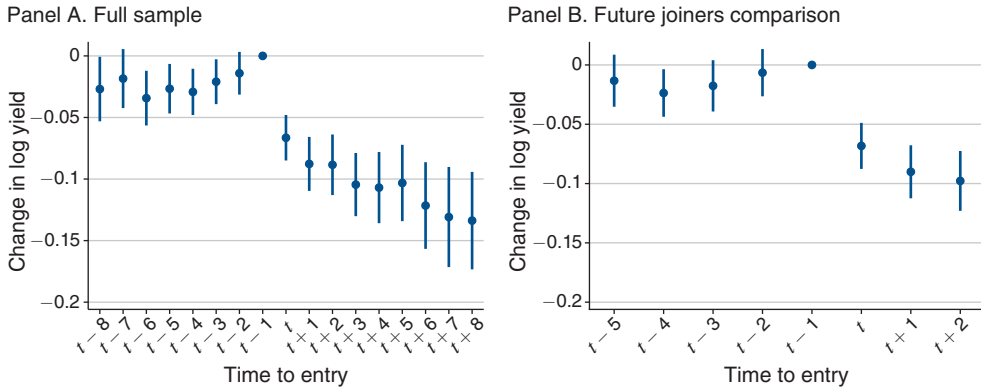


FIGURE 6. CA ENTRY AND YIELD

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). Dependent variable is defined as $\log(\text{enrollment}/\text{admits})$. The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

Given this reduction in yield, colleges might need to increase the number of admitted students in order to satisfy their capacity, as discussed in the theoretical model. As shown in column 3 of Table 1, we indeed find a large increase—11 percent—in the number of admitted students in our baseline regression. When restricting the comparison group to future joiners, as shown in column 3 of Table 2, we document a somewhat smaller effect. But this 8 percent increase remains economically and statistically significant. As shown in the event study for the full sample (Figure 7, panel A), there is a discontinuous 10 percent increase in admits upon joining, and the effect again increases over time, rising to 17 percent after 8 years. When restricting the comparison group to future joiners, as shown in the right panel, we again document a discontinuous increase, with further evidence of an increasing effect after just two years (from roughly 7 percent to 11 percent).

Finally, we investigate whether selectivity has changed, as measured via acceptance rates. Here the results are more mixed. When analyzing the full sample via a regression, we find no evidence of a change in selectivity, as shown in column 4 of Table 1. When restricting the comparison group to future joiners, by contrast, we document a 3 percent reduction in acceptance rates (column 4 of Table 2). This difference is statistically significant at conventional levels. The event study for the full sample in Figure 8, panel A documents a small drop in the acceptance rate after joining and larger effects in the years following CA adoption, with a 5 percent reduction in acceptance rates 8 years after joining the CA. When restricting the comparison group to future joiners as shown in the Figure 8, panel B, we document a sharp 2 percent reduction in acceptance rates upon joining, and the effect is stable over time in this case.

To summarize, we find strong evidence that CA entry increased the number of applications (consistent with reduced frictions) and reduced yield (consistent with large student choice sets). We find mixed evidence regarding a hypothesized fall in acceptance rates but strong evidence that the number of admitted students increased.

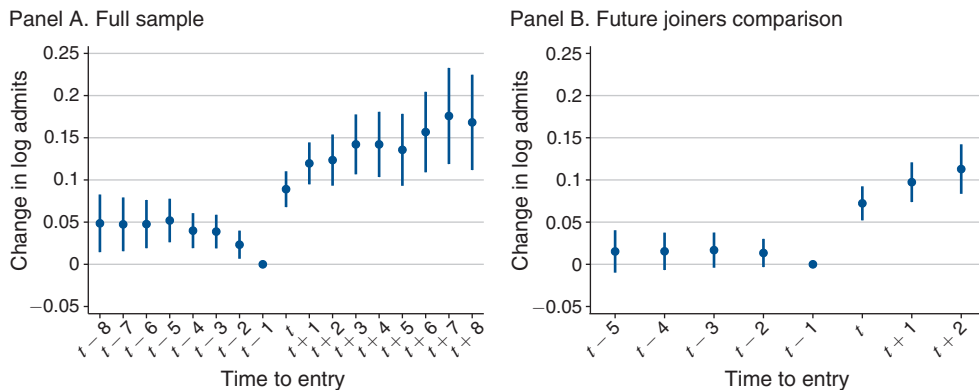


FIGURE 7. CA ENTRY AND THE NUMBER OF ADMITS

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

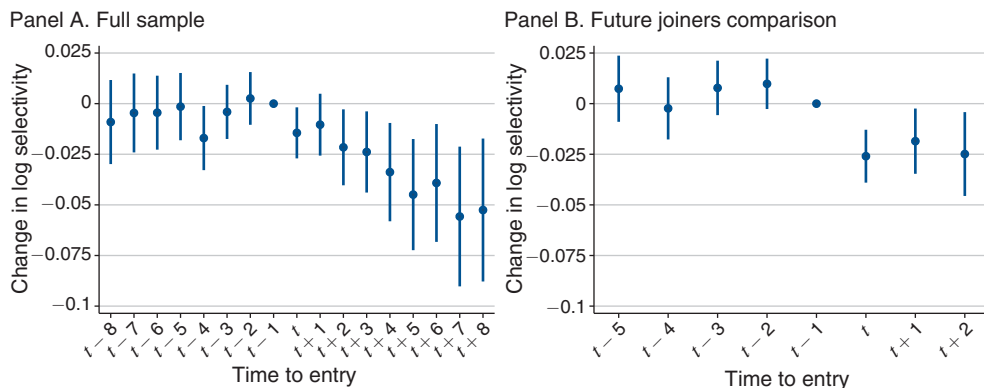


FIGURE 8. CA ENTRY AND SELECTIVITY

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

D. Geographic Integration

Given the documented reduction in frictions and increased student choice sets, we next examine the role of the CA in contributing to recent trends in geographic integration. In the online Appendix, we first provide evidence that the geographic integration documented by Hoxby (2000), covering the period 1949–1994, has continued into our sample period. In particular, we find an increase over time in the average distance traveled by students and an increase in the fraction of out-of-state students.

Using College Board data, we measure the extent to which the CA has contributed to these trends in geographic integration. As shown in column 1 of Table 3, the fraction of out-of-state students rises by 1.4 percentage points in the years after

TABLE 3—CA ENTRY AND STUDENT PROFILES

	Out-of-state % (1)	SAT 25th ptile (2)	SAT 75th ptile (3)	Enroll % non-White (4)	Ugrad enroll % Pell (5)
CA member	0.0136 (0.0045)	4.4189 (2.7833)	9.8235 (2.5404)	0.0082 (0.0039)	-0.0242 (0.0048)
Observations	37,621	28,504	28,510	27,494	26,782
Clusters	1,597	1,428	1,428	1,567	1,762

Notes: Results from constant coefficient specification (equation (3)) on full sample. Specifications in columns 1–4 use the College Board data while column 5 uses separate Pell and IPEDS data. All specifications include institution and year fixed effects. Standard errors clustered by institution in parentheses.

TABLE 4—CA ENTRY AND STUDENT PROFILES: FUTURE JOINERS COMPARISON

	Out-of-state % (1)	SAT 25th ptile (2)	SAT 75th ptile (3)	Enroll % non-White (4)	Ugrad enroll % Pell (5)
CA member	0.0064 (0.0033)	2.9630 (2.0422)	2.4967 (1.9184)	0.0193 (0.0047)	-0.0104 (0.0039)
Observations	12,297	11,475	11,475	10,303	10,521
Clusters	487	474	474	480	469

Notes: Results from constant coefficient specification (equation (3)), restricting the comparison group to future joiners. Specifications in columns 1–4 use the College Board data while column 5 uses separate Pell and IPEDS data. All specifications include institution and year fixed effects and an indicator for joiner versus comparison group (see online Appendix for details). Standard errors clustered by institution in parentheses.

joining, a roughly 5 percent increase relative to the sample average of 30 percent out-of-state students. When restricting the comparison group to future joiners, we document an increase of roughly 0.6 percentage points, as shown in column 1 of Table 4. The corresponding event study for the full sample as reported in Figure 9, panel A documents an immediate increase in the fraction of out-of-state enrollment of roughly 0.7 percentage points following a school joining the CA, and this effect roughly doubles, to over 1.2 percentage points, 8 years after joining the CA. When restricting the comparison group to future joiners, we find smaller increases—of roughly 0.5 percentage points—and these estimates are less precise due to the smaller sample size.

In the online Appendix, we document similar results using our data from IPEDS on student migration. In particular, CA entry leads to an increase in out-of-state students. In addition, IPEDS includes information on state-to-state migration of college students, and we use this information to measure the average distance that students travel to attend college. We find that entry into CA increases distance traveled, and this effect largely comes from an increase in attendance from nearby states.

To summarize, we find that the CA has contributed to geographic integration, with an increase in the fraction of out-of-state students when a school joins the CA. This is consistent with the predictions of our theoretical model, under which the CA induces more students to apply to and ultimately attend out-of-state institutions following a reduction in the costs of applying to multiple institutions. Below, we

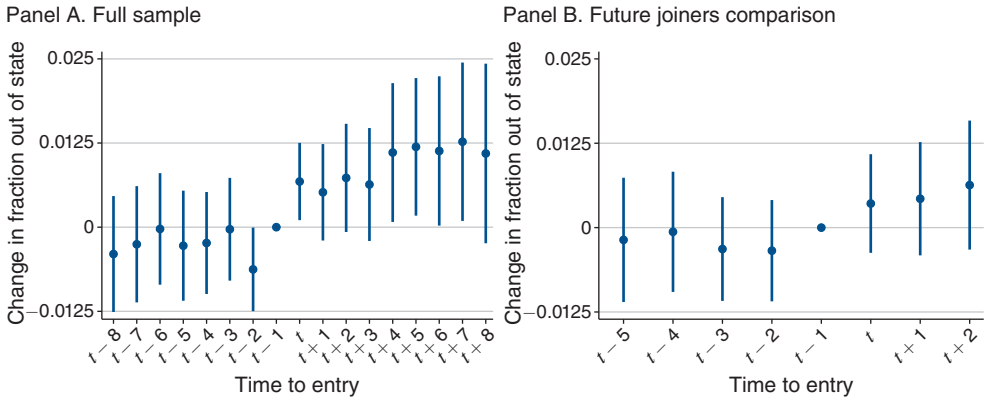


FIGURE 9. CA ENTRY AND OUT-OF-STATE ENROLLMENT

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

consider the source of these out-of-state students via an investigation of network effects associated with the CA.

E. Network Effects

Given the network effects predicted by an extension of the theoretical model, we hypothesize that the effects of the CA should be increasing with the size of the network.²⁶ We investigate these issues by examining the outcomes described above, including in our regressions an interaction term between CA membership and network size, defined as the number of CA members in year t .

As shown in the first column of Table 5, we find that increasing the size of the network by 100 members increases the effect of CA membership on applications by 1.3 percent. For example, joining the CA at the beginning of our sample period, with roughly 100 members, increases applications by 8.5 percent. By the end of our sample period, when the CA had 700 members, joining the CA increases applications by over 16 percent. We do not find any evidence of network effects when studying yield, as shown in column 2 of Table 5, and we find some evidence of reverse network effects when examining the number of admits, as shown in column 3 of Table 5. When measuring selectivity, by contrast, we find strong evidence of network effects, as shown in the final column of Table 5, with larger reductions in acceptance rates as the number of CA members grows.

We next study network effects in the context of geographic integration. As shown in column 1 of Table 6, we find that the effect of CA membership is increasing with network size. For example, joining the CA at the beginning of our sample period, with roughly 100 members, increases the fraction of out-of-state students by

²⁶For an overview of network effects in two-sided markets, see Rysman (2009).

TABLE 5—CA ENTRY, NETWORK SIZE, AND ADMISSIONS OUTCOMES

	log applications (1)	log yield (2)	log admits (3)	log selectivity (4)
CA member	0.0726 (0.0304)	-0.1155 (0.0262)	0.1933 (0.0342)	0.1220 (0.0240)
CA × network	0.0131 (0.0077)	0.0079 (0.0067)	-0.0217 (0.0086)	-0.0352 (0.0058)
Observations	34,519	34,360	34,556	34,468
Clusters	1,632	1,631	1,632	1,632

Notes: Results from constant coefficient specification (equation (3)) on full sample, also including an interaction term between CA membership and network size. Network size is defined as the number of CA members in a year and is measured in hundreds; the average network size across all institution-years is 325 schools. All specifications include institution and year fixed effects. Standard errors clustered by institution in parentheses.

TABLE 6—CA ENTRY, NETWORK SIZE, AND STUDENT PROFILES

	Out-of-state % (1)	SAT 25th pctile (2)	SAT 75th pctile (3)	Enroll % non-White (4)	Ugrad enroll % Pell (5)
CA member	0.0015 (0.0074)	-6.0308 (5.2642)	-21.7286 (4.8148)	0.0044 (0.0065)	0.0480 (0.0075)
CA × network	0.0033 (0.0019)	2.9767 (1.2973)	8.9885 (1.2274)	0.0010 (0.0016)	-0.0184 (0.0018)
Observations	37,621	28,504	28,510	27,494	26,782
Clusters	1,597	1,428	1,428	1,567	1,762

Notes: Results from constant coefficient specification (equation (3)) on full sample, also including an interaction term between CA membership and network size. Network size is defined as the number of CA members in a year and is measured in hundreds. Specifications in columns 1–4 use the College Board data while column 5 uses separate Pell and IPEDS data. The average network size across all institution-years is 325 schools for the College Board data and 350 schools for the IPEDS data. All specifications include institution and year fixed effects. Standard errors clustered by institution in parentheses.

only 0.5 percentage points. By the end of our sample period, when the CA had 700 members, joining the CA increases out-of-state enrollment by approximately 2.5 percentage points.

We further examine the role of network effects in geographic integration using data on the source states of enrollments. Recall that the extension of our theoretical model to three colleges predicts that institutions joining the CA are likely to see a greater increase in applications from students in states that already have a significant number of CA colleges. For example, if New York has high CA penetration (i.e., many New York schools are in the CA), then we might expect that UW–Madison will attract more New York students after joining the CA, since these New York students are already using the platform to apply to CA colleges in New York.

To examine these issues around the CA and student migration from source to destination states, we use IPEDS biennial migration data. We provide two measures of CA penetration (P_{st}), one based upon the fraction of colleges in source state s at time t that are members of the CA and one that is similar but weighted by college enrollment, recognizing that large colleges naturally receive more applications and

are thus more salient to applicants from source state s . 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 provides a test of whether enrollment from high-CA-penetration states increases when college c joins the CA. In our specification, the unit of observation is now a college by source state by year, and we thus include college-by-source-state fixed effects and source-state-by-time fixed effects:

$$(5) \quad \ln(N_{sct}) = \beta_1 CA_{ct} + \beta_2 P_{st} + \beta_3 CA_{ct} \times P_{st} + \mu_{sc} + \mu_{st} + \epsilon_{sct}.$$

The key parameter of interest, β_3 , captures the increase in enrollment from states with high CA penetration when a college joins the CA, after controlling for differences across states according to CA penetration and overall differences across colleges in CA membership.

As shown in column 1 of Table 7, the coefficient on the interaction between CA membership and CA penetration is positive and statistically significant, suggesting that the increase in applications upon joining the CA is derived from students applying to other CA schools. In terms of the magnitude of the effect, schools joining the CA enroll 3 percent more students from source states with no CA penetration but over 20 percent more students from source states with complete CA penetration (i.e., $P_{st} = 1$). This positive interaction effect is robust to restricting the comparison group to future joiners (column 2), using the full sample but weighting CA penetration by enrollment (column 3), and both restricting the comparison group to future joiners and using the weighted penetration measure (column 4).

F. Stratification

Our final research question involves whether the CA changed the types of students enrolling at institutions. We investigate heterogeneity along three dimensions: test scores, race, and income. First, given the reduction in frictions, the increased student choice sets, and geographic integration, we investigate whether the CA has contributed to a widening of the gap between more selective and less selective institutions. Second, to the extent that colleges value racial diversity, they might be able to reshape the racial composition of their student body due to the larger applicant pool after joining the CA. Third, motivated by our theoretical extension that considers income, we investigate whether joining the CA increases the fraction of high-income students enrolling at the university.

SAT Scores.—We begin by documenting general trends in SAT scores at different types of institutions. To do so, and in parallel with Figure 2, we 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 10, there is a large and increasing gap in SAT scores at the seventy-fifth percentile between selective schools (the top 50 liberal arts, top 50 private, and top 50 public), and less selective institutions

TABLE 7—CA ENTRY, NETWORK SIZE, AND SOURCE STATES

	log enrollment (1)	log enrollment (2)	log enrollment (3)	log enrollment (4)
CA member	0.0338 (0.0102)	0.0072 (0.0099)	0.0371 (0.0101)	0.0150 (0.0096)
CA member × CA penetration	0.1767 (0.0419)	0.1888 (0.0662)		
CA member × CA penetration wtd			0.1138 (0.0223)	0.0909 (0.0342)
Observations	1,052,079	539,223	1,052,079	539,223
Clusters	1,652	486	1,652	486

Notes: Results from specification (5), estimated using IPEDS data on the number of freshmen from each source state for each institution. Columns 1 and 3 show results from the full sample while columns 2 and 4 restrict the comparison group to future joiners. All specifications include institution-source and year-source fixed effects; specifications in columns 2 and 4 also include an indicator for joiner versus comparison group (see online Appendix for details). Standard errors clustered by institution in parentheses.

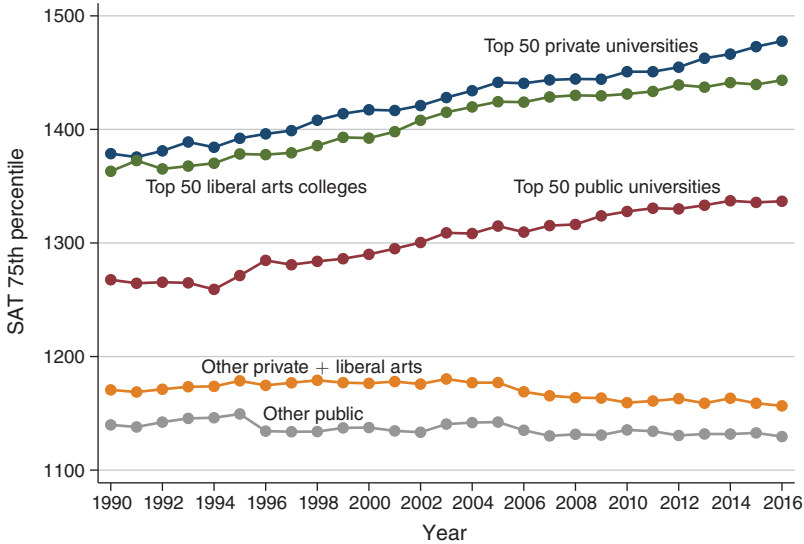


FIGURE 10. STRATIFICATION IN HIGHER EDUCATION

Notes: Figure plots average SAT scores at the seventy-fifth percentile in each year, weighted equally, across schools within a category. Categorization of schools comes from the data Appendix of Bound, Lovenheim, and Turner (2010).

over our sample period. Thus, there is evidence of increasing stratification, in general, during our sample period.

Given that the CA is disproportionately used by selective institutions, as 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. As shown in columns 2 and 3 of Table 3, there is a general increase in the SAT scores of enrolled freshman following entry into the CA. In particular, SAT scores at the twenty-fifth percentile increase by 4.4 points and SAT scores at the seventy-fifth percentile increase

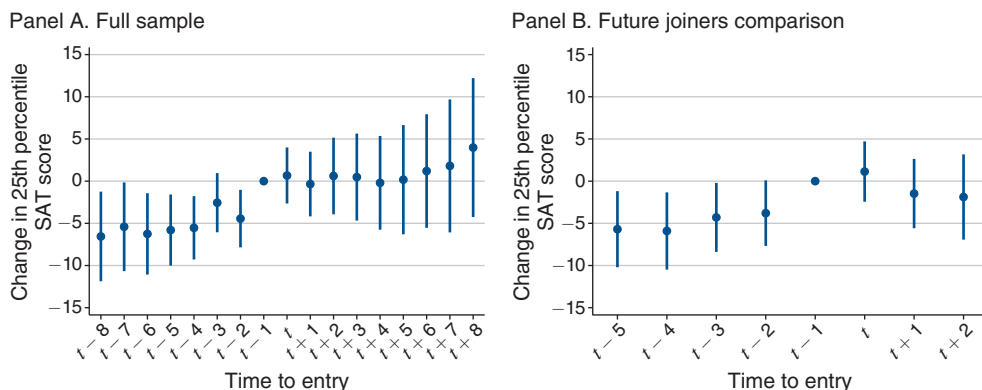


FIGURE 11. CA ENTRY AND SAT SCORES AT TWENTY-FIFTH PERCENTILE

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

by 9.8 points, although only the latter effect is statistically significant.²⁷ When restricting the comparison group to future joiners, the results remain positive but are now statistically insignificant, as shown in columns 2 and 3 of Table 4. Figure 11 (both panels) suggests that SAT scores do not increase at the twenty-fifth percentile level. Figure 12, by contrast, documents increases in SAT scores at the seventy-fifth percentile upon CA entry, although there is evidence of pre-trends when using the full sample (panel A) and the results lack precision when restricting the comparison group to future joiners (panel B). When studying network effects in Table 6, we find strong evidence that any increases in SAT scores are stronger with a larger network; SAT scores at the seventy-fifth percentile, in particular, rise by over 40 points when a school joins the CA with 700 members.

Racial Composition.—Given that universities tend to value racial diversity, they might be able to use the larger applicant pool after joining the CA to increase the fraction of non-White students.²⁸ While we do not have any data on the racial composition of the applicant pool, we can examine the racial composition of the entering class. As shown in column 4 of Table 3, we document an increase of nearly 1 percentage point in the fraction of non-White students following CA entry, relative to the sample average of 32 percent. Restricting the comparison group to future joiners, we document a 1.9 percent increase in the fraction of non-White students in the entering class, as shown in column 4 of Table 4. The full sample event study, as shown in Figure 13, panel A, documents a discontinuous increase in the fraction

²⁷One interpretation of the difference in effects between the twenty-fifth and seventy-fifth percentiles, in the context of our theoretical extension to heterogeneous student ability, is that the fraction of high test score 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 students with low test scores regardless of CA membership.

²⁸Arcidiacono and Lovenheim (2016) review the literature measuring the degree of racial preferences in admissions and note that less selective institutions have less scope for such preferences, given that they tend to admit a large fraction of applicants.

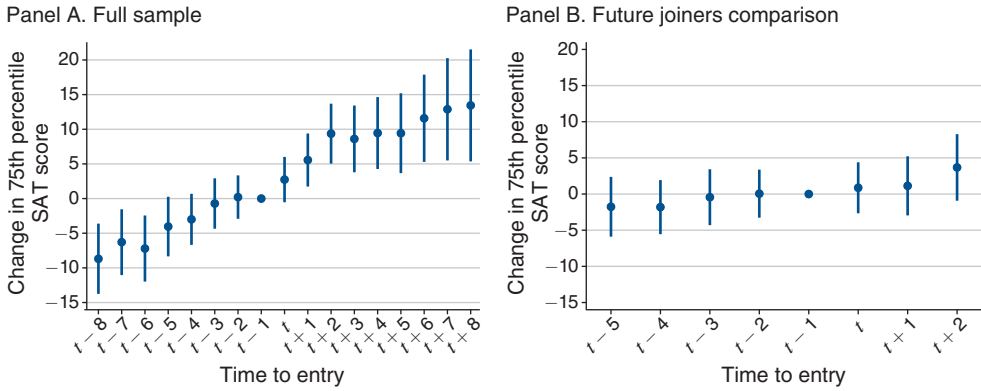


FIGURE 12. CA ENTRY AND SAT SCORES AT SEVENTY-FIFTH PERCENTILE

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

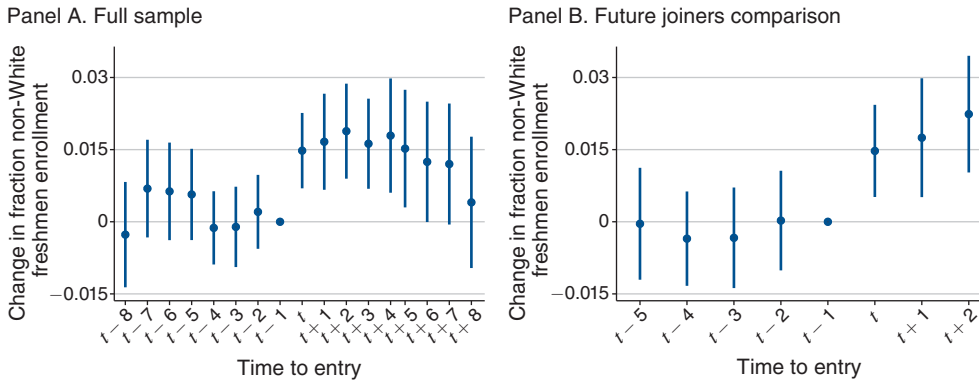


FIGURE 13. CA ENTRY AND FRACTION NON-WHITE FRESHMEN ENROLLMENT

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

of non-White students in the year of entry. The results are generally noisy, however, and statistically insignificant starting eight years after CA entry. When restricting the comparison group to future joiners (Figure 13, panel B), the results are cleaner, with no pre-trends, a discontinuous increase of 1.5 percentage points at time of entry, and stable or slightly increasing effects thereafter. We find no evidence of network effects in terms of racial composition, as shown in column 4 of Table 6.

Income Distribution.—As predicted by our theoretical extension to income, higher-income students might be more responsive to the CA relative to low-income students, for whom the financial costs associated with applying are more salient. To measure the fraction of low-income students, we use data on the fraction of students with Pell Grants. Importantly, while our previous measures are based upon

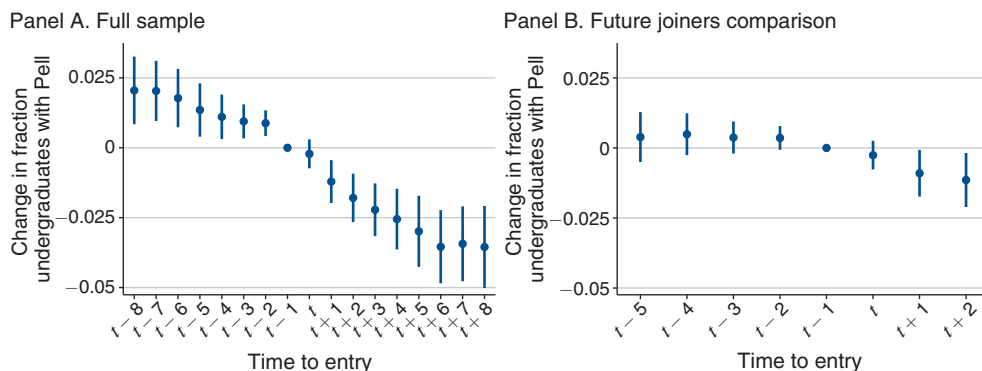


FIGURE 14. CA ENTRY AND FRACTION RECEIVING PELL GRANTS

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). Dependent variable is percentage of all undergraduates receiving Pell Grants; data on Pell Grants comes from the Department of Education. The left panel shows results from the full sample while the right panel restricts the comparison group to future joiners.

the entering freshman class, these measures of Pell Grants are based upon the entire student body. Given this, we do not expect to see discontinuous changes upon entry and instead expect to see more gradual changes in outcomes following CA entry. As shown in column 5 of Table 3, we find a reduction of 2.4 percentage points in the percentage of students receiving Pell Grants, a large effect relative to the baseline of 43 percent. When restricting the comparison group to future joiners, we find a smaller decrease of about 1 percentage point. Event studies using the full sample, as shown in Figure 14, panel A, document gradual declines in the percentage of students receiving Pell Grants, with a reduction of roughly 3.5 percentage points 8 years after joining the CA. Likewise, when restricting the comparison group to future joiners, we document a gradual decline, with a reduction of 1 percentage point two years after joining the CA. As noted above, gradual, rather than discontinuous, declines are consistent with the fact that the Pell data cover all enrollees and not just first-year students. As shown in the final column of Table 6, we again find strong evidence of network effects, with the percentage of students receiving Pell Grants falling by 8 percentage points when a school joins the CA with 700 members.

Summary.—We find that the CA leads to changes in the degree of diversity on campus. Regarding SAT scores, CA colleges tend to be more selective, with higher test scores at baseline. We find some evidence that SAT scores increase when joining the CA, but those results are imprecise; if there is an effect of the CA on stratification by test scores, it is an increase. We find stronger evidence that the CA increases racial diversity, with a robust increase in the fraction of non-White students. Given that CA members tend to have fewer non-White students prior to joining the CA, as shown in Table 8, the CA has reduced racial stratification. Finally, we also find evidence that the CA reduces income diversity, with a documented reduction in the fraction of students receiving Pell Grants. Given that CA members tend to have higher-income students prior to joining the CA, as shown in Table 8, the CA has increased stratification according to income.

TABLE 8—CA MEMBERSHIP, RACE, AND INCOME

	Never joiners	Current CA members	Future CA members
Percent non-white (1990)	25.0	17.7	21.5
Percent Pell (1999)	44.1	19.3	33.2

Notes: Row 1 uses College Board data to show the percentage of non-White freshmen in 1990 for schools that never join the CA, schools that joined in 1990 or earlier, and schools that will join between 1991 and 2017. Row two uses the Pell data to show analogous results for the percentage of all undergraduates receiving Pell Grants in 1999, the first year for which we have Pell Grant data.

G. Other Outcomes

While we have attributed our results to the Common Application, it remains possible that the CA was adopted as part of a larger institutional strategy to increase applications and to change the composition of the student body. Thus, the effects that we have attributed to joining the CA might instead reflect other changes in institutional strategy adopted at the same time as CA entry.

To address this issue, we next explore changes in other university policies and outcomes. While we lack data on university recruiting and outreach, we do attempt to examine three other potential aspects of larger institutional strategies. First, it could be the case that universities want to expand their sizes and adopt the CA at the same time in order to increase the sizes of their applicant pools. Second, universities might have attempted to increase the quality of instruction at the same time as CA adoption. Finally, in an effort to increase the number of applications, admissions offices might have both joined the CA and reduced application fees. We examine these outcomes in Table 9 and show the event studies from the future joiners specification in Figure 15; the event studies from the full sample are shown in online Appendix Section B2.

In column 1 of Table 9, we find some evidence of universities increasing their sizes when joining the CA, with a 3.7 percent increase in enrollment, when analyzing the full sample.²⁹ When restricting the comparison group to future joiners in column 4, however, we do not find any increases in the sizes of universities. Likewise, the full sample event study in online Appendix Figure B3 shows an increase, but Figure 15, panel A shows only a small increase or no increase when restricting the comparison group to future joiners.

To investigate the quality of instruction, we use data on the number of faculty holding PhDs. As shown in column 2 of Table 9, we do not find any changes in the log number of faculty holding PhDs upon CA entry, and results are similar when restricting the comparison group to future joiners (column 5). Event studies—Figure 15, panel B and online Appendix Figure B4—do not document any changes in the number of faculty holding PhDs when a school joins the CA, either.

Finally, we investigate whether application fees change upon CA entry. As shown in column 3 of Table 9, application fees tend to increase, if anything, upon CA entry,

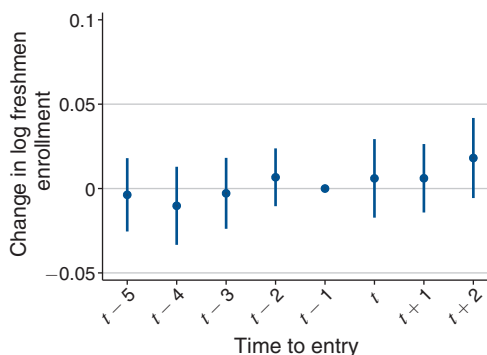
²⁹It is also possible that this result reflects university sizes being below capacity prior to joining the CA.

TABLE 9—CA ENTRY AND OTHER OUTCOMES

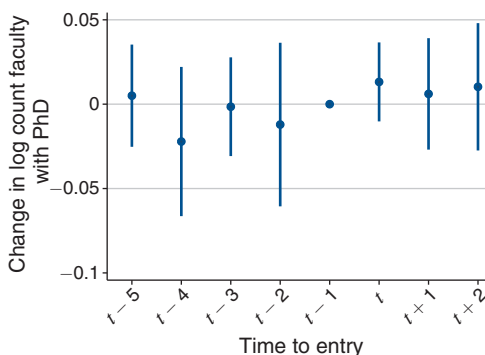
	log enrollment (1)	log PhD faculty (2)	Application fee (3)	log enrollment (4)	log PhD faculty (5)	Application fee (6)
CA member	0.0372 (0.0147)	0.0055 (0.0161)	1.6358 (0.6834)	0.0113 (0.0102)	0.0161 (0.0164)	0.8290 (0.5199)
Observations	38,359	33,882	40,881	12,427	10,821	12,733
Clusters	1632	1602	1632	489	474	489

Notes: Results from estimating the constant coefficient specification (equation (3)); columns 1–3 show results for the full sample while columns 4–6 show results restricting the comparison group to future joiners. All specifications include institution and year fixed effects, and specifications in columns 4–6 also include an indicator for joiner versus comparison group (see online Appendix for details). Standard errors clustered by institution in parentheses.

Panel A. Enrollment



Panel B. PhD faculty count



Panel C. Application fee

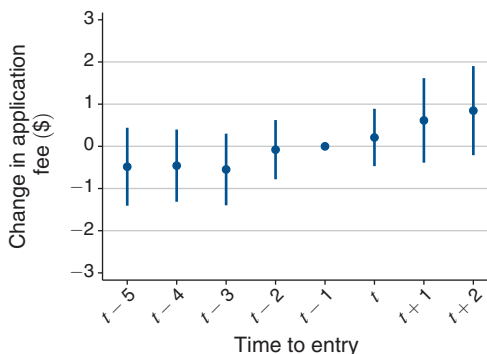


FIGURE 15. CA ENTRY AND OTHER OUTCOMES, FUTURE JOINERS COMPARISON

Notes: Figures plot coefficients and 95 percent confidence intervals on the relative join year variables from the event study specification (equation (4)). All three panels show results from restricting the comparison group to future joiners; results using the full sample are shown in the online Appendix.

with a statistically significant increase in application fees of \$1.64 when examining the full sample and a statistically insignificant increase of \$0.83 when restricting the comparison group to future joiners. The event studies are inconclusive, with

Figure 15, panel C showing at most a small increase, and online Appendix Figure B5 showing no stable pattern.

Taken together, we find little evidence that joining the CA is part of larger institutional strategies to increase the number of applications. We do find some evidence that enrollment grows upon CA entry but no evidence of changes in instructional quality or application fees, which, if anything, tend to increase.

IV. Conclusion

Consistent with model predictions, we find that the CA has significantly altered college admissions. In particular, after joining the CA, institutions experience an increase in the number of applications, consistent with a reduction in frictions. There is also a significant reduction in yield, consistent with increased student choice due to the CA. We also provide evidence that the CA has accelerated geographic integration, with more out-of-state students. Moreover, these out-of-state students tend to come from other states with significant CA penetration, patterns consistent with network effects of the CA. Taken together, these results suggest that the CA, by reducing application costs, has reduced frictions and increased student choice sets in college admissions, resulting in a more integrated market. Finally, we provide some evidence that CA entry is associated with changes in the composition of students, with increases in racial diversity, fewer low-income students, and weaker evidence of increases in SAT scores.

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