Screening mechanisms and student responses in the college market ☆

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ABSTRACT

In light of the sizeable financial and time investments associated with obtaining a postsecondary degree, the choice of where to apply and enroll should be a deliberate and thoughtful process. In this paper we exploit changes in application fees and admissions essay requirements, to demonstrate that students strongly respond to small costs in the college application process. Using a new method to identify major competitors of each college, we find that these small screening mechanisms negatively impact application volume and divert student applications to colleges to which they otherwise would not have applied. There is limited evidence that measures of enrollment and retention are affected.

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1. Introduction

Attending college is increasingly both costly (College Board, 2013) and time consuming (Bound, Lovenheim, & Turner, 2012) and represents one of the largest investments people make in their lives. In many contexts, behavioral economics has improved upon standard economic models and results,[1] but with an investment as large as education, one would expect students to engage in a thoughtful and deliberate application and enrollment process that maximizes expected utility. However, there is an increasingly large literature that shows students are not behaving optimally in the college application and enrollment process. For example, students rely on rules of thumb when applying to colleges that results in too few applications (Pallais, 2013) and many high-achieving low-income students fail to apply to or enroll in colleges that are academic "matches," which can also be more affordable and have higher graduation rates (Hoxby & Avery, 2013). We offer new evidence that students respond to relatively small costs by examining the screening mechanisms that colleges in the United State implement to manage the applicant pool. Specifically, we investigate the use of application essays and application fees and show that small changes in these screening mechanisms have sizeable effects on applications and enrollment.

Higher education is a canonical example of a market that requires applicants and has a tradeoff when attracting applicants – there may be too few desirable candidates if there are too few applicants, but there may be too many undesirable candidates, who are difficult to distinguish from desirable candidates, if there are too many applicants. In the latter portion of the tradeoff, colleges run the risk of accepting undesirable students and rejecting desirable students. Hence, colleges frequently implement screening mechanisms.[2]

☆ This research does not reflect the views of the College Board.

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[1] A review of the history, models, and empirical examples can be found in several places, including Mullainathan and Thaler (2001), Camerer and Lowenstein (2004), and DellaVigna (2009).

[2] This line of reasoning is discussed in Autor (2001) in relation to the "wiring" of the labor market.

However, the type of screen and magnitude of the associated costs imposed on the students are at the discretion of the college and have the potential to be quite small. While little empirical evidence exists regarding the effects of these small costs, the popular press provides anecdotal evidence of surprisingly large changes in application numbers in response to changes in application procedures. For example, Boston College added an application essay in order to improve yield and get the "best-suited" enrolling class, all by way of a dramatic decrease in the number of applications (Dunn, 2013; Hoover, 2013). Reed College eliminated its application fee in hopes of spurring more applications, particularly among low-income students (Kiley, 2013). However, these anecdotes lack the context to understand how much, if any, of the responsiveness is actually attributable to such changes, nor do they track the changes in application procedures to changes in student enrollment.

To investigate the effect of colleges' screening mechanisms on student outcomes, we assemble aggregate application and enrollment data from the Annual Survey of Colleges (ASC) and Integrated Postsecondary Education Data System (IPEDS) on 885 four-year colleges for the entering cohorts of 2003–2011. In 2003, 49.8% of four-year colleges required an application essay and that number increased to 56.8% by 2011. Over the same time period, approximately 50% of colleges increased their application fees, at least once. Among colleges that increased application fees, the average increase was 30%, which only amounts to $10.

We use within college variation in application-level screening mechanisms across the 2003–2011 cohorts to identify the effects admission essays and application fees on student application and enrollment behavior, as well as first-year retention. A natural concern with this methodology is that colleges are endogenously responding to changes in popularity by erecting such measures to reduce application volume. Although this would lead to coefficients biased toward zero, we address this possibility with a novel control for aggregate student interest in a college – the number of SAT Score Sends a college receives in the previous year, which we describe in more detail in the data and methodology sections.

With this methodology, we find that requiring an essay decreases the number of applications received at that college by 6.5%. We also find that increasing the application fee by 10% corresponds to almost a 1% decrease in applications. Also, unlike Liu, Ehrenberg, and Mrdjenovic (2007), the paper most similar to ours, we find that adoption of the Common Application by colleges yields no discernible impact on the number of applications received. This is in part due to an expanded set of covariates and perhaps due to a difference in sample years, in which the Common Application is already relatively diffuse.[3]

Next, we examine how these changing application policies affect enrollment. Overall, requiring an essay decreases the number of matriculants at an institution by 3.2%, but the application fee has no discernible effect. However, Black and Hispanic enrollment is estimated to decrease by over 6% when an essay is required and by 1.1% when the application fee increases by 10%. We do not see evidence of heterogeneous effects by parental income or education.

Part of the rationale for having essays and application fees is to aid in the selection of a desirable class, by whatever terms the admission office deems appealing. A desirable class may confer advantages, such as better quality or matched students, which may improve retention and graduation rates (Light & Strayer, 2000). Similarly, an undesirable class can hurt the prominent statistics of a college, such as graduation rates, which may someday be tied to federal funding. In a result consistent with this notion, we find that requiring an essay increases yields rates, which are the fraction of accepted students who matriculate. This screening mechanism may help colleges identify students who are more likely to matriculate, perhaps because they are a better match. While an improved yield is generally appealing to admissions officials, so are higher SAT scores. However, there is no evidence that SAT scores of matriculants increases with the essay or application fee changes. Finally, we find that these application criteria have no impact on freshman retention rates, perhaps calling into question the assumption that these criteria serve to substantially improve match.

We then address whether a college's decision to change screening criterion diverts applications and enrollees to its competitor institutions. If students are simply diverting their applications to competitor colleges, there may be no welfare loss, given that many competitors offer similar educational experiences. However, if students do not divert their applications but instead apply to fewer colleges, there may be a lower probability of enrolling in college (Smith, 2013) or a lower expected wages (Pallais, 2013). This is the first paper to have detailed evidence on each college's competitors to perform this type of analysis. We identify competitor institutions through the universe of SAT Score Sends, which allow us to identify colleges that have the most overlap in student interest with one another. We find that when a college increases application fees, applications are nearly all diverted to its major competitor, but only a fraction of applicants are diverted to its major competitor when an essay is required.

This research adds to several strands of literature. First, it highlights the fact that students respond to seemingly small costs. Since college is such a large investment compared to writing a short admissions essay or paying an additional $10 in application fees, it seems remarkable that small changes in application requirements have the power to influence student application or enrollment behavior. Nevertheless, there is a growing literature, both inside and outside of education, which suggests that people's decisions overly rely on small cues, such as these screens. For example, people often rely on rules of thumb (Lacetera, Pope, & Sydnor, 2012; Pallais, 2013) or relatively salient information (Chetty, Looney, & Kroft, 2009; Finkelstein, 2009; Luca & Smith, 2013). These small cues are important in light of the numerous papers that demonstrate that students lack full information (Dillon & Smith, 2013). Related, students tend to over-respond to small and immediate costs such as financial aid offers (Cohodes & Goodman, 2014), financial aid forms (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2012), application fees

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[3] Liu, Ehrenberg, and Mrdjenovic (2007) are primarily concerned with the diffusion of the Common Application but briefly address the effects of application fees, obtaining an estimate consistent with ours. This paper focuses on the effects of application fees and essays, with newer data and potentially important covariates, as well as exploring the effects of competitors, which their data cannot address.

(Hoxby & Turner, 2013), guidance (Carrell & Sacerdote, 2013), and test taking (Bulman, 2013; Goodman, 2013; Hurwitz, Smith, Niu, & Howell, in press; Klasik, 2013).

Also, while there is ample theoretical research on screening mechanisms[4] and empirical research on screening mechanisms conditional on applying to a college (e.g., Espenshade, Chung, & Walling, 2004; Hurwitz, 2011; Long, 2004) or a job (e.g. Bertrand & Mullainathan, 2004; Cameron & Heckman, 1993; Dale & Krueger, 2002), there is little research about the screening mechanisms used to attract or dissuade applicants and the efficacy of such efforts.[5] This paper adds to that literature.

2. Data

This research assembles data from several different sources, which are described in detail below. In addition to the yearly college characteristics obtained from IPEDS and the Annual Survey of Colleges (ASC), we use College Board (CB) data to determine colleges' competitor institutions and National Student Clearinghouse (NSC) for further enrollment information.

2.1. IPEDS and ASC

Application, admissions and enrollment information, as well as information on application requirements, for 885 four-year colleges between the Fall 2003 and Fall 2011 application cohorts are obtained from the Integrated Postsecondary Education Data System (IPEDS) and the Annual Survey of Colleges (ASC). This represents relatively traditional colleges from a pool of over 2000 four-year colleges in the United States. From IPEDS, we incorporate into our analyses the following time variant characteristics: each year's in-state and out-of-state tuition and the 25th and 75th percentile of math and verbal SAT scores, number of freshmen enrollees disaggregated by race, number of federal student aid recipients, acceptance rate, yield, and freshmen retention rate. Colleges with no application data are dropped.[6]

The ASC provides more detail on application requirements than can be obtained from IPEDS. It allows us to create variables on whether an application essay is required, the application fee (in current dollars), whether the college accepts application fee waivers, whether the university offers early admissions, whether the SAT or ACT are required, and the application deadline date. We also observe 16 academic and non-academic admissions considerations that survey respondents deem "very important," "important," "considered," or "not considered."[7] For simplicity of analysis, we recode each

of these 16 variables to equal to one if the response is "very important" or "important" and zero otherwise. For some sensitivity checks, we recode each variable to equal one if the response is "very important" and zero otherwise.

We also supplement this data with whether a college accepts the Common Application. The Common Application is a consortium of colleges that agree to use and accept the same student application for admission, in exchange for a few dollars per applicant.[8] In 2003, there were 241 colleges accepting the Common Application and by 2011, that number was 456. Standard application fees are not a part of the Common Application, and many colleges still require supplemental essays; therefore these two screening criteria vary across colleges and within colleges over time among Common Application colleges. Controlling for a college's status as a Common Application college is necessary because we aim to isolate the impact of a college-specific essay on this paper's outcomes, rather than that of the Common Application, which also contains a generic essay requirement. That is, all Common Application colleges receive the same essay from the student.

2.2. CB and NSC

The College Board data consists of all high school students who take the SAT, which consists of approximately 1.5 million students per cohort. Along with the students' performances on the test, a student fills out a questionnaire regarding basic demographics such as gender, race, and parental income and education.[9]

In the summer of 2011, CB data for the graduating high school classes of 2004, 2006–2010 were merged with NSC data, which traces students' postsecondary careers.[10] It identifies all colleges to which the students enroll and when they enrolled. For each college in each year, we determine how many CB test taking students enroll right after high school graduation. The CB data are complementary to the IPEDS data and allow us a more nuanced view of the heterogeneous impacts of the addition/removal of screening criteria beyond the enrollment data in IPEDS. For example, IPEDS allows for the estimation of heterogeneous enrollment impacts by race, but not by family income, which *can* be obtained from the CB data.[11,12]

We also construct state time-varying controls using CB data. Specifically, we calculate the number of students who take the SAT in each state in each year and the average SAT

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[4] See Gibbons and Waldman (1999) for an overview of the asymmetric information literature.

[5] One notable exception is the use of technology to attract job applicants across several literatures, including economics, management, human resources, information technology, and sociology. However, this research addresses obtaining more (potential) applicants, not distinguishing between desirable and undesirable applicants.

[6] A college typically has or does not have application data in all years, but in very few instances, applications are missing for a few years, leaving a slightly unbalanced panel.

[7] Criteria include state residency, character/personal qualities, application essay, racial/ethnic status, recommendations, rigor of secondary school

record, standardized test scores, interview, extracurricular activities, talent and ability, alumni relation, religious affiliation/commitment, class rank, geographical residence, volunteer work, and work experience.

[8] Currently, the fee is $3.75 or $4.75 per applicant, depending on whether the college has signed an exclusivity agreement with the Common Application. We find no evidence that the colleges pass this fee on to the students through the application fee (using a college fixed effects regression).

[9] The questionnaire is upon registration for the last SAT attempt. Not all students respond to all questions.

[10] NSC contains information from over 3300 colleges, which covers 96% of the student population. 2005 data were not matched to CB data.

[11] Some institutions' counts of enrollees differ between the NSC and IPEDS because not all enrollees at postsecondary institutions will have taken a College Board product. As we show, overall estimates are fairly insensitive to the choice of IPEDS versus NSC.

[12] This issue is discussed more in the methodology section.

Table 1
Summary statistics.

Variable	Source	Obs	Mean	Median	Std. Dev.	Min.	Max.
Number of applications	IPEDS	7882	6019	3277	7384	64	61,545
Number of Score Sends	CB	7834	5920	2607	8870	100	73,203
Number of Score Sends/number of applications	CB/IPEDS	7834	1.05	0.86	4.79	0.02	195
Freshmen enrollees	IPEDS	6163	1131	605	1312	20	9707
Number of enrolled Black and Hispanic students	IPEDS	6163	204	76	322	0	3393
Fraction of enrolled Black and Hispanic students	IPEDS	6163	18	12	19	0	100
Number of Pell recipients enrolled	IPEDS	6150	288	152	335	0	3340
Fraction of Pell recipients enrolled	IPEDS	6151	29	26	15	0	100
Acceptance rate	IPEDS	7882	64	67	18	3	100
Yield	IPEDS	7881	37	34	15	7	100
Average SAT of matriculants (math + verbal)	IPEDS	7874	11	1080	1	7	15
Freshman retention rate	IPEDS	5283	78	79	11	16	100
Application essay required	ASC	7882	0.54	1	0.50	0	1
Application fee ($)	ASC	7425	40.30	40.00	13.28	0	100
Common Application college	CA	7882	0.32	0	0.47	0	1

Notes: Data from approximately 885 four-year colleges in the U.S. between the 2003 and 2011 application cohorts. Sources are IPEDS, Annual Survey of Colleges (ASC), College Board (CB) data, and the Common Application (CA).

among those students. These data are supplemented with state-year high school graduating cohort sizes from WICHE.[13]

2.2.1. Score Sends

The CB data also include where students send their SAT scores (Score Sends), which is often required when applying to college.[14] However, scores can be sent without applying to a college and an application can be submitted without sending scores. Upon registration of the SAT, students are given four free Score Sends to colleges, which are only free up to a few days after the test taking day. After the test, or for more than four Score Sends, each additional Score Send to a college costs about $10.[15]

We use Score Sends for two purposes. First, we aggregate the number of Score Sends to each college in each lagged year to proxy for student interest or popularity of the college.[16] The previous year's Score Sends represent aggregate student interest in the college, but the measure is not affected by the contemporaneous year's application procedures. This does not account for a surge in student interest within the most recent year, which colleges can endogenously respond to by changing their application procedures.

Second, we also use Score Sends to define a college's closest competitor as the college with the most Score Send overlap. To identify this closest competitor, we take the subset of students who send scores to a particular college. Using that subset of students, we then count the number of Score Sends submitted to each of the other postsecondary institutions. The closest competitor is the college with the highest count. On average, 32% of the students at a college also send scores to the closest competitor. Note that we have identified the closest competitor for SAT takers. The closest competitor of colleges where enrolling students tend to take the ACT or no

admissions exam at all instead of the SAT may be different from the ones identified in this study.

3. Summary statistics and trends

3.1. Summary statistics

Table 1 presents the summary statistics for the primary variables in the data. Overall, the average college in the sample receives 6019 SAT Score Sends. Among colleges for which score send and application data are both available, the average number of applications is slightly less than the number of Score Sends, which is perfectly reasonable because a few applicants to these institutions will have submitted ACT scores. The average number of enrollees at the colleges over the sample period is just over 1100. Also, the average number of Black and Hispanic enrollees is 204.

We also show several other outcome variables that institutions typically discuss. Across the college-by-year observations, the average acceptance rate is 64% and the average yield – the fraction of accepted students who enroll – is 37%. The average SAT of matriculants is 1098 and the average freshmen retention rate is 78%. Finally, 54% of college-by-year observations are accompanied by an application essay requirement. Across all years, the average application fee is $40 and 32% of the college-by-year observations specify the acceptance of the Common application.

3.2. Trends in essays, applications, and fees

Table 2 presents the averages of some of the key variables in this analysis over time. Some of these changes are the identifying variation that is exploited in the main analyses. The first column shows the average number of applications over time. There is a general increase in the number of applications received by the 885 sampled colleges between 2003 and 2007, and a slight decline thereafter. In part, this may be due to the financial crises and the way students' application decisions responded.

Unlike applications, the average number of Score Sends is monotonically increasing. By 2011, the average number

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[13] Available online http://www.wiche.edu/knocking-8th.

[14] We exclude the 0.2% of observations that have no information on Score Sends.

[15] The cost was slightly less in early years. Low-income students can qualify to take the SAT for free and get free Score Sends.

[16] Hence, we utilize Score Sends in 2002 in addition to the sample years, 2003–2011.

Table 2
Changes in applications and requirements over time.

Year	Avg. # of applications	Avg. # of Score Sends	Avg. # of enrollees	Avg. application fee	Changed application fee count	Avg. application fee change	Percent requiring essay	Added essay count	Removed essay count	Common Application count
2003	5795	4743	1062	36.78	–	–	49.83	–	–	222
2004	5625	4917	1086	38.10	114	8.06	52.11	28	9	230
2005	5958	5154	1119	38.90	89	8.69	52.88	21	12	246
2006	6212	5521	1145	39.70	93	8.03	53.23	12	9	260
2007	6408	5946	1163	40.35	71	7.76	53.39	10	7	273
2008	6167	6382	1165	41.12	73	6.75	55.07	16	5	295
2009	5881	6765	1181	41.72	65	7.08	55.58	14	8	326
2010	5667	7237	–	42.89	81	8.80	56.73	6	5	338
2011	5550	7586	–	43.52	83	6.27	56.84	7	2	368
Total	–	–	–	–	669	–	–	114	57	–
Average	6019	5920	1131	40.30	84	7.74	53.94	14	7	284

Notes: Data from approximately 885 four-year colleges in the U.S. between the 2003 and 2011 application cohorts. Sources are IPEDS, Annual Survey of Colleges, College Board data, and the Common Application.

of Score Sends increased by nearly 60%, relative to 2003. By contrast, the average number of enrollees between 2003 and 2009 increased by only 11% (and the corresponding increase in Score Sends between 2003 and 2009 is 43%). The average application fee in 2003 was $36.78 and that slowly increased to $43.52 in 2011, which is in line with inflation.[17] An average of 84 colleges changed their fee every year, which amounts to 50% of the colleges over the sample period. The increases are, on average, just about $8 (or 20%). Almost 15% of sampled colleges revised application fees multiple times and a few colleges decreased their fees.

There has been a slow upward trend in the number of colleges requiring an essay, increasing from 49.83% in 2003 to 56.84% in 2011. This upward trend masks the fact that some colleges actually dropped their essay requirements over this time period, as shown in the next two columns of Table 2. In addition, across the entire sample, colleges that require essays have an average SAT of approximately 1150 versus a 1030 for colleges with no essay. This is consistent with more selective colleges trying to deter undesirable applicants and less selective colleges trying to encourage enough applicants to fill their available seats.

Finally, the last column shows the upward trend in the number of colleges adopting the Common Application. In the relatively short time frame examined in this paper, the number of four-year colleges accepting the Common Application increased from 222 to 368.

4. Methodology

We are primarily interested in the effect of essay requirements and application fees on several outcomes. Those outcomes include the number of applications for first-year admission to college s in year t, denoted $\log(Applications_{st})$ and the number of first-year enrollees at college s in year t, denoted $\log(Enrollees_{st})$. We also examine other outcomes such as acceptance rate, yield rate, and average SAT scores of matriculants.

The main specification is presented below, where the unit of observation is a college-year and y_{st} represents one of the

above outcomes:

$$y_{st} = \alpha + \beta_1 \, Essay_{st} + \beta_2 \log(AppFee_{st})$$
$$+ \beta_3 \, ComApp_{st} + \gamma X_{st} + S + T + \varepsilon_{st} \qquad (1)$$

where $Essay_{st}$ is an indicator as to whether college s in year t requires an application essay. The variable $\log(AppFee_{st})$ is the logarithm of the cost of an application fee, in nominal U.S. dollars, for college s in year t. $ComApp_{st}$ is an indicator equal to one if the college is a member of the Common Application in year t, and zero otherwise.

X_{st} is a vector of time varying controls including: dummies for whether an application fee waiver exists, whether the college offers early admissions, whether the ACT or SAT is required, and the application deadline (days relative to January 1st). It also includes the lagged in-state tuition, out-of-state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants. These last few variables are lagged by one year so as to demonstrate the characteristics of the colleges when students are deciding whether to apply. X_{st} also contains a set of state time-varying controls including: the number of high school graduates, the number of SAT takers, and the average SAT score among takers.

Finally, S is a vector of college fixed effects, T is a vector of year fixed effects, and ε_{st} is a mean zero i.i.d. random variable.

4.1. Identification

We are primarily interested in the vector of β coefficients in Eq. (1) and interpreting them as causal effects.[18] To do so, we briefly discuss the identification strategy and its limitations. In doing so, we use the number applications as the motivating outcome variable, without loss of generality.

All specifications include college and year fixed effects.[19] This means that we exploit the variation within a college over time. However, there exist other things that affect the number of applications, beyond adding or removing an essay, an application fee change, and joining the Common Application.

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[17] Source: Bureau of Labor Statistics: http://www.bls.gov/cpi/.

[18] Note that Essay Required and Common Application positively covary and so controlling for both is important for identification.

[19] With the exception of some preliminary OLS regressions to investigate potential bias.

First and foremost, we control for X_{st}, which contains all the aforementioned IPEDS and ASC variables related to the application process and additional variables that may determine whether someone wants to attend, and consequently even apply. The vector also contains time-varying state trends like cohort size and the size and composition of students interested in attending college (i.e. number of SAT takers and their average scores).

Even with college fixed effects and time varying controls, the biggest threat to identification is the presence of unobservables that affect the number of applications or enrollees that can bias results. Broadly speaking, these unobservables come in two forms that bias results in opposite directions. First, there may be unobservable contemporaneous changes in college practices that affect applications and enrollment, which likely bias results upward. For example, colleges that eliminate essays may also implement an unobservable marketing campaign to attract more applicants. To assess this bias, we add in the time-varying variables X_{st} Eq. (1) and observe the stability of the estimates. We also have several specifications that add in controls for the qualitative importance of 16 admission considerations. While these criteria may not be of great importance on their own, changing responses are indicative of new leadership or processes in the admissions office. If the β coefficients were not stable under all of these specifications, there would be cause for concern as to whether there are other omitted variables which are correlated with essay and application fee changes.

The second form of unobservables that may bias results are changes in college popularity or student interest. That is, a college may introduce an application-suppressing screening criterion (e.g. require an essay or increase the application fee) in direct response to a surge in popularity above and beyond that experienced by the typical postsecondary institution. Assuming popularity is still on the rise, alterations in screening criteria aimed to counteract surges or declines in relative popularity (or simply due to changes in the university's preferences in applications and enrollment) will generate β coefficients that are biased toward zero. To account for this type of bias, our preferred specification controls for the lagged number of Score Sends, as demonstrated below:

$$y_{st} = \alpha + \beta_1 Essay_{st} + \beta_2 \log(AppFee_{st}) + \beta_3 ComApp_{st} + \cdots$$
$$+ \beta_4 \log(ScoreSends_{st-1}) + \gamma X_{st} + S + T + \varepsilon_{st} \quad (2)$$

As described in the above subsection on Score Sends, this controls for students' interest in a college and the college's overall popularity from the previous year, before the student has had the opportunity to carefully examine the colleges' specific admissions requirements.

4.2. Theoretical predictions

On one hand, basic economic theory suggests that increased costs (larger application fees and essay requirements) will be associated with fewer applications since fewer students will find the benefit of an application greater than the relatively high cost. However, there is a literature that says price can be a signal of quality (e.g. Bagwell & Riordan, 1991) and within the educational context, some have suggested that colleges maintain high sticker prices to cultivate the image

of prestige (see for example Riggs, 2011). If students equate inflated application fees and supplemental essays with prestige, these screening mechanisms may paradoxically increase application volume.

The expected effect of these small screening mechanisms on student enrollment is also not clear cut. Falling applicant numbers may pose a real threat to filling first-year classes for some institutions. Alternatively, smaller applicant pools may allow admissions officers to better identify desirable candidates and consequently enroll more students through an increased student yield on admissions offers. Similarly, the perceived prestige associated with these application barriers may increase the yield and ultimately enrollment, even if application numbers fall. Moreover, these screens may have different effects on different types of students and consequently lead to changed applicant pool and set of enrollees.

Colleges often claim to use these screening mechanisms as a means of improving match quality between students and the college (see for example Landergan, 2013). Assuming perfect information, increasing application costs should unambiguously improve match quality and the corresponding outcomes that reflect quality of fit between student and institution. First, only students who are relatively more interested in attending will apply. Second, conditional on applying, the college has fewer applications to sift through and has the option to more thoroughly evaluate candidates. However, we know that not all students have perfect information, particularly low-income and rural students (Dillon & Smith, 2013; Hoxby & Avery, 2013) and hence these costs could deter the best matched students, reducing measures of fit, like retention rate. In addition, in this context, the students who are deterred from applying to a college due to screening mechanisms may be marginal students who would have never been accepted or enrolled and so there may be no effect on match, despite the theoretical predictions. Moreover, the screening mechanisms may simply replace existing less efficient screens and have no impact on enrollment or match. Therefore, the impacts of these screening criteria remain an important empirical question.

5. Results

5.1. Applications

Table 3 presents the main set of results where the logarithm of the number of applications is the dependent variable. In the first column, we regress the outcome variable on the two variables of most interest: essay required and the logarithm of application fee. We also include the college's status as a Common Application college and college and year fixed effects. Using this within college variation, we estimate that requiring an essay is associated with over 6% fewer applications. Also, the elasticity estimate implies that a 10% increase in application fees leads to a 0.76% decrease in applications. This specification also shows that joining the Common Application increases applications by 3.5%.

Columns 2 and 3 separately add college level time-varying controls and admission survey importance controls, both of which may be correlated with the primary variables of interest. That is, there may be contemporaneous policy changes that are driving the previous estimates. We find that our

Table 3
Effect of application criteria on applications (dependent variable = log(# of applications)).

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Essay required	−0.063***	−0.066***	−0.057**	−0.058***	−0.058***	−0.065***	–
	(0.021)	(0.021)	(0.023)	(0.022)	(0.020)	(0.019)	–
log(application fee)	−0.076*	−0.090**	−0.083*	−0.078*	−0.078**	−0.089**	−0.090**
	(0.045)	(0.045)	(0.044)	(0.044)	(0.038)	(0.040)	(0.040)
Common Application college	0.035*	0.040*	0.049**	0.049**	0.029	0.022	0.020
	(0.021)	(0.021)	(0.021)	(0.021)	(0.019)	(0.019)	(0.019)
Lagged log(# Score Sends)	–	–	–	–	0.309***	0.296***	0.295***
	–	–	–	–	(0.093)	(0.097)	(0.097)
Essay added	–	–	–	––	–	–	−0.048**
	–	–	–	–	––	–	(0.019)
Essay removed	–	–	–	–	–	–	0.099***
	–	–	–	–	–	–	(0.038)
College and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time varying college controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Admission survey "important" controls	No	No	Yes	Yes	Yes	No	No
State cohort controls	No	No	No	Yes	Yes	Yes	Yes
Observations	7424	7369	7010	7010	6982	7338	7338
R-squared	0.400	0.404	0.414	0.416	0.475	0.461	0.462

Notes: Standard errors are in parentheses and clustered at the college level. *** means significant at 1% level, ** at 5%, and * at 10%. Time varying college controls include: dummies for application fee waiver, early admissions, and SAT or ACT required, as well as linear application deadline relative to January 1st, instate tuition, out of state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants. Admission survey "important" controls include 16 admission criteria coded as one if response is "very important" or "important" and zero otherwise. For each state and year, state cohort controls include high school graduating cohort size, number of SAT takers, and average SAT score. *R*-squared for fixed effects models only describes within variation.

results are insensitive to the addition of these controls.[20] Results are also stable to the inclusion of state-year varying controls, as demonstrated in column 4. Though there may still be unobservables to worry about, the stability of the coefficients reassures us that the bias from unobservables is likely to be minimal.[21]

Column 5 controls for our measure of college popularity (lagged Score Sends) and the estimates remain stable with some improvement in estimate precision associated with the log application variable. Column 6, our preferred specification for all other tables, simply excludes the admission importance controls in order to increase sample size and reports similar estimates as those shown in the previous columns. In these later columns, we only see suggestive evidence that the Common Application affects the number of applications. Finally, column 7 separately estimates the effect of colleges adding or eliminating essays. It appears that removing an essay has a slightly larger impact than adding an essay, though, the differences in magnitude are not statistically different from one another.

Across all years the typical sampled college received about 6000 applications and had an application fee of about $40. Our estimates suggest that, at this typical college, an essay requirement removes about 400 students from the applicant pool. Also, a $10 increase in application fees (about a 25% increase) would be expected to reduce the number of applications by about 140. Finally, it also suggests that an essay is

valued to students the same as an approximately 65% increase in the application fee, which is about $26.

5.2. Enrollment

The next question to address is whether these changes to application processes affect enrollment. Table 4 displays the results where the outcome variable is the logarithm of the number of enrollees and using specification 6 from Table 3, the preferred specification.

The first column suggests that requiring an essay decreases the number of students enrolled by 3.3%. Application fees have no statistical effect. The next column shows that an essay requirement reduces the minority enrollment by about 6%, though, the relative composition of minority enrollment is unchanged, suggesting that non-minority enrollment decreases as well. We also find that increasing the application fee by 10% leads to a decrease in minority enrollment of about 1.16% and the fraction of minorities by about 2 percentage points. The next set of columns show disaggregated estimates by federal financial aid status.[22] Application essays and application fees do not seem to affect enrollment of these students, in absolute or relative terms.

Turning to the results using CB enrollment data, application fee increases appear to increase the enrollment of wealthier students, a finding that is consistent with the proposition that application fees may serve as a signal of quality and prestige. For low-income students, this signal may be counteracted by the financial burdens of more expensive application fees, but the magnitude of typical increases (about $10) is unlikely to pose any hardships for higher income students. In addition, low-income students can receive

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[20] Result are insensitive to whether using admission survey "important" definition or "very important" definition.

[21] Recognizing that the stability of estimates upon adding controls is not the only assumption required to assess any bias, we also estimate the bounds of the treatment effect assuming proportional selection of observable and unobservables, as described in Oster (2013). The estimated bounds are on essay required and application fee still negative and often larger in magnitude than those shown in Table 4.

[22] The majority of this aid is through Pell Grants and it is only for first-time full time students. This aid is based on need, not merit.

Table 4
Effect of application criteria on enrollment (dependent variable = log(# type of enrollee) or fraction of type of enrollee).

Variable	Type of enrollee										
	All (IPEDS)	Black and Hispanic (IPEDS)		Federal aid recipients (IPEDS)		Parental income (College Board)			Parents' highest education (College Board)		
		Number	Fraction	Number	Fraction	<$50k	$50k–$100k	>$100k	High school	Some college, two-year degree	Bachelor's degree
Essay required	−0.033**	−0.062**	−0.229	−0.010	0.465	−0.031	−0.016	−0.033	−0.032	−0.032	−0.023
	(0.014)	(0.029)	(0.266)	(0.022)	(0.645)	(0.021)	(0.018)	(0.029)	(0.025)	(0.021)	(0.018)
log(application fee)	0.013	−0.116**	−2.110***	−0.019	−1.728	0.001	0.066*	0.144**	0.011	0.037	0.140***
	(0.028)	(0.054)	(0.646)	(0.044)	(1.135)	(0.046)	(0.036)	(0.066)	(0.053)	(0.046)	(0.040)
Common Application college	0.013	0.050	0.122	−0.026	−1.187**	−0.043	−0.023	−0.023	−0.054**	−0.009	0.006
	(0.019)	(0.032)	(0.319)	(0.028)	(0.554)	(0.030)	(0.022)	(0.033)	(0.026)	(0.022)	(0.021)
Lagged log(# Score Sends)	0.071*	0.067*	−0.355	0.043	−0.428	0.023	0.056	0.122	0.032	0.044	0.069*
	(0.041)	(0.040)	(0.277)	(0.036)	(0.373)	(0.025)	(0.035)	(0.075)	(0.032)	(0.033)	(0.040)
Observations	5763	5759	5763	5753	5762	4629	4630	4623	4607	4630	4631
R-squared	0.105	0.229	0.132	0.403	0.308	0.113	0.120	0.479	0.068	0.062	0.183

Notes: Standard errors are in parentheses and clustered at the college level. *** means significant at 1% level, ** at 5%, and * at 10%. All regressions have college and year fixed effects. All regressions also control for time varying college controls, including: dummies for application fee waiver, early admissions, and SAT or ACT required, as well as linear application deadline relative to January 1st, instate tuition, out of state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants and also time varying state controls including: high school graduating cohort size, number of SAT takers, and average SAT score. In College Board data, students can choose not to identify their parental income or education, so there is a set of non-responding students whose results are not displayed.

application fee waivers so they may not even be subject to the fees, which could explain the null effect. The last set of results uses first-year enrollment by parental education subgroups from the CB data as outcomes. We find that essays have no impacts on student enrollment across parental education groupings. Increases in application fees have positive enrollment effects on students with parents who have earned a bachelor's degree or higher – the same students who are most likely to be grouped in the higher income categories.

Parental income and education results rely heavily on SAT coverage, since only SAT takers are counted in the outcome variable. Hence, we test the robustness of these six columns in two ways. First, we only use the subset of colleges for which CB has good coverage. To accomplish this, we select only colleges where at least half of the first-time full-time IPEDS enrollees show up in the CB cohort. Second, we only use the subset of colleges where at least 50% of students submit their SAT scores, as reported in IPEDS. The Table 4 results are insensitive to these restrictions and are located in Table A1.

5.3. Other outcomes

Table 5 investigates whether these changing policies affect other outcomes. The first column shows that there are no statistical effects on the acceptance rate associated with an essay requirement or increased application fees. Since an essay requirement and increased application fees both reduce the number of applications, the parameter estimates in column 1 suggest that when these barriers are erected, colleges ultimately accept fewer applicants. The essay requirement does increase the yield on admitted students by about 4%, suggesting that the essay may serve as a tool to screen out students with no intention of matriculating. In conjunction with the previous results, which indicate an essay decreases enrollment, the results in Table 5 show that the increased yield from an essay requirement is insufficient to offset the decreased application volume.

The next two columns in Table 5 show whether these screens have any impact on the quality of first-year students. Column 3 indicates that essays and application fees do not affect the average SAT of matriculants. These screens may have removed from the applicant pool marginal students whose probability of admission is low and would have been detected by admissions reviewers in the absence of the screens, or they may have reduced application volume across the range of admissibility. Regardless of how the composition of the applicant pool changed, the screens do not affect the academic quality of incoming students. Finally, the last column demonstrates that there is no statistical impact on the freshman retention rate. While yield rates are improved, there is no evidence that the process has improved match enough to statistically alter retention rates.

5.4. Competitors

This section tests whether the application policies shift applications to other colleges or whether students reduce their total number of applications. To do so, we estimate Eq. (2) but also include variables for whether the largest competitor changes its policies. Hence, we are actually testing the

Table 5
Effect of application criteria on other factors.

Variable	Dependent variable			
	log (acceptance rate)	log (yield)	Average SAT of enrollees	log (freshman retention rate)
Essay required	− 0.004	0.040***	− 0.018	0.005
	(0.011)	(0.015)	(0.020)	(0.005)
log(application fee)	0.048	0.012	− 0.000	0.015
	(0.033)	(0.036)	(0.034)	(0.013)
Common Application college	0.002	− 0.024	0.034*	− 0.011
	(0.014)	(0.017)	(0.019)	(0.007)
Lagged log(# Score Sends)	− 0.055***	− 0.084**	0.096***	− 0.007
	(0.021)	(0.033)	(0.024)	(0.005)
Observations	7338	7337	6436	4953
R-squared	0.066	0.222	0.141	0.010

Notes: Standard errors are in parentheses and clustered at the college level. *** means significant at 1% level, ** at 5%, and * at 10%. All regressions have college and year fixed effects. All regressions also control for time varying college controls, including: dummies for application fee waiver, early admissions, and SAT or ACT required, as well as linear application deadline relative to January 1st, instate tuition, out of state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants and also time varying state controls including: high school graduating cohort size, number of SAT takers, and average SAT score.

Table 6
Effect of competitor's application criteria.

Variable	Dependent variable					
	log (# applications)	log (# enrollees)	log (# Black and Hispanic enrollees)	log (# of federal aid recipients)	Average SAT of enrollees	log (freshman retention rate)
Essay required	− 0.066***	− 0.027**	− 0.057**	− 0.006	− 0.006	0.006
	(0.020)	(0.013)	(0.027)	(0.022)	(0.019)	(0.005)
Competitor essay required	0.026	0.008	0.009	0.008	0.031	0.003
	(0.018)	(0.010)	(0.024)	(0.018)	(0.020)	(0.005)
log(application fee)	− 0.072*	0.010	− 0.082	0.003	0.016	0.009
	(0.040)	(0.030)	(0.057)	(0.048)	(0.032)	(0.011)
Competitor log(application fee)	0.065*	0.061**	− 0.028	0.041	− 0.000	0.002
	(0.037)	(0.025)	(0.053)	(0.039)	(0.029)	(0.010)
Common Application college	0.025	0.014	0.056*	− 0.016	0.036*	− 0.011
	(0.019)	(0.020)	(0.033)	(0.030)	(0.018)	(0.007)
Competitor Common Application college	− 0.021	− 0.013	− 0.066*	− 0.072**	0.006	− 0.000
	(0.020)	(0.015)	(0.034)	(0.031)	(0.023)	(0.007)
Lagged log(# Score Sends)	0.313***	0.070	0.062	0.043	0.104***	− 0.008
	(0.120)	(0.046)	(0.042)	(0.041)	(0.026)	(0.005)
Competitor lagged log(# Score Sends)	− 0.021	0.014	0.082***	0.000	− 0.022	0.001
	(0.020)	(0.012)	(0.031)	(0.021)	(0.015)	(0.004)
Observations	6558	5142	5138	5133	5767	4422
R-squared	0.489	0.116	0.238	0.414	0.183	0.010

Notes: Standard errors are in parentheses and clustered at the college level. *** means significant at 1% level, ** at 5%, and * at 10%. All regressions have college and year fixed effects. All regressions also control for time varying college controls, including: dummies for application fee waiver, early admissions, and SAT or ACT required, as well as linear application deadline relative to January 1st, instate tuition, out of state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants and also time varying state controls including: high school graduating cohort size, number of SAT takers, and average SAT score.

effect of a competitor changing its admission policies on the college at hand. Table 6's estimates show the results of this exercise.[23]

The first column presents results when the dependent variable is the logarithm of the number of applications. Similar to before, when an essay is required, applications decrease by an estimated 6.6%. However, when a competitor adds an essay, there is a small (2.6%), albeit statistically im-

precisely estimated, increase in applications. This positive coefficient, with a magnitude more than one-third as large as the 6.6% figure, is suggestive that students are substituting applications to competitor colleges when an essay is required. Similar to the initial result in this section, increases in application fees deter applications, but when a competitor increases application fees, the focal college experiences an increase in applications. The magnitudes of the column 1 coefficients on application fee and competitor application fee are quite similar, demonstrating that application fee increases cause students to substitute between competing colleges.

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[23] Columns have different numbers of observations because some colleges or their competitor are missing information.

The next two columns indicate that required essays reduce enrollment, especially among minorities, but when a competitor has an essay, enrollment at the focal college is unaffected. By contrast, when closest competitors increase application fees, an enrollment increase (in addition to an increase in application volume) ensues. The last three columns suggest that there are no effects of changes in competitors' application processes on the number of financial aid recipients, the average SAT scores, or freshman retention rate of the focal college.

We also test the robustness of this result by only using the set of colleges where the ratio of the number of Score Sends to the number of applications is greater than 0.75.[24] This allows us to consider only the subset of colleges that primarily use the SAT (not ACT) in admissions and thus we have a greater likelihood of capturing their true competitors. Results are qualitatively similar and presented in Appendix Table A2.

In all of these analyses, it is important to note that the competition between the two colleges may not be reciprocal. That is, the competitor college may have a different major competitor that receives applications and enrollees. This may especially be true for subgroups, like minorities. Regardless, we do find evidence of a diversion effect, suggesting the identification of colleges' competitors is reasonably accurate.

6. Conclusion

In this study, we offer evidence that two important screeners (the application fee and an application essay) used at the application stage do, in fact, impact the number of applications received by colleges. There is also evidence that essays reduce the number of enrollees, particularly minorities, but not the quality of enrollees, as measured by average SATs, and match quality, as measured by retention rates. There are several limitations worth noting. From an empirical perspective, we attempt to purge bias from our estimates through the inclusion of fixed effects for college and year as well as a rich set of college-specific time variant characteristics. Despite the stability of estimates with and without controls, we cannot fully rule out unobservable contemporaneous changes.

It is also important to address external validity. The colleges that add essays are quite similar to colleges that do not add essays, in terms of size, tuition, and whether public or private. Similarly, most colleges increase application fees at one point or another. These similarities provide support for the external validity of the estimates. However, colleges that eliminate essays are substantially smaller and more likely to be private colleges than the rest of the colleges. Therefore, estimates, such as the asymmetric effect on removing an essay may only hold for those types of colleges.

Another point worth addressing is whether the impressive responses that students have to these screening mechanisms represent rational behavior. Simple demand theory suggests that an increase in cost through the time required to write an additional essay or a $10 increase in application fees should decrease the quantity of applications, which could explain

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[24] Results are not too sensitive to the choice of 0.75. This ratio balances precision with the attempt to find strongly SAT colleges.

Table A1
Effect of application criteria on enrollment – robustness checks on College Board data (dependent variable = log(# type of enrollee)).

Variable:	Colleges where ratio of CB enrollees to IPEDS enrollees > 0.5						Colleges where at least 50% of students submit SAT					
	Parental income			Parents' highest education			Parental income			Parents' highest education		
	<$50k	$50k–$100k	>$100k	High school	Some college, two-year degree	Bachelor's degree	<$50k	$50k–$100k	>$100k	High school	Some college, two-year degree	Bachelor's degree
Essay required	−0.012	−0.004	−0.029	−0.019	−0.013	−0.009	−0.038*	−0.026	−0.038	−0.044*	−0.043**	−0.036*
	(0.020)	(0.016)	(0.028)	(0.024)	(0.018)	(0.016)	(0.022)	(0.018)	(0.028)	(0.023)	(0.021)	(0.019)
log (application fee)	−0.014	0.059	0.116*	−0.029	0.033	0.105***	−0.000	0.025	0.040	−0.020	0.005	0.095**
	(0.041)	(0.036)	(0.060)	(0.051)	(0.040)	(0.035)	(0.048)	(0.036)	(0.050)	(0.056)	(0.047)	(0.040)
Common Application college	−0.044*	−0.020	−0.014	−0.049*	0.002	0.015	−0.046	−0.020	−0.017	−0.044*	−0.015	0.001
	(0.027)	(0.019)	(0.031)	(0.026)	(0.020)	(0.018)	(0.029)	(0.022)	(0.032)	(0.026)	(0.023)	(0.022)
Lagged log(# Score Sends)	0.022	0.036	0.107	0.030	0.026	0.057	0.033	0.073	0.113	0.026	0.062	0.086
	(0.022)	(0.025)	(0.069)	(0.032)	(0.021)	(0.035)	(0.032)	(0.053)	(0.088)	(0.029)	(0.047)	(0.063)
Observations	4503	4504	4499	4487	4503	4504	3771	3769	3764	3766	3771	3770
R-squared	0.190	0.188	0.542	0.084	0.101	0.310	0.097	0.131	0.546	0.104	0.088	0.226

Notes: Enrollment calculated in College Board data. Standard errors are in parentheses and clustered at the college level. *** means significant at 1% level, ** at 5%, and * at 10%. All regressions have college and year fixed effects. All regressions also control for time varying college controls, including: dummies for application fee waiver, early admissions, and SAT or ACT required, as well as linear application deadline relative to January 1st, instate tuition, out of state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants and also time varying state controls including: high school graduating cohort size, number of SAT takers, and average SAT score. Students can choose not to identify their race, income, or parental education, so there is a set of non-responding students whose results are not displayed.

Table A2
Effect of competitor's application criteria.

Variable	Dependent variable					
	log(# applications)	log(# enrollees)	log(# Black and Hispanic enrollees)	log(# of federal aid recipients)	Average SAT of enrollees	log(freshman retention rate)
Essay required	− 0.049**	− 0.030**	− 0.067**	− 0.009	− 0.012	0.007
	(0.023)	(0.012)	(0.033)	(0.025)	(0.018)	(0.005)
Competitor essay required	0.016	0.021*	0.029	0.013	0.045*	0.003
	(0.016)	(0.012)	(0.030)	(0.021)	(0.024)	(0.005)
log(application fee)	− 0.048	− 0.003	− 0.069	0.003	0.033	0.004
	(0.035)	(0.025)	(0.056)	(0.047)	(0.031)	(0.013)
Competitor log(application fee)	0.060	0.052**	− 0.005	0.055	0.003	− 0.014
	(0.041)	(0.026)	(0.058)	(0.046)	(0.034)	(0.011)
Common Application college	0.089***	0.027	0.065*	− 0.019	0.043**	− 0.013
	(0.021)	(0.021)	(0.038)	(0.035)	(0.019)	(0.008)
Competitor Common Application college	0.006	− 0.008	− 0.059	− 0.054	− 0.023	− 0.010
	(0.019)	(0.015)	(0.051)	(0.039)	(0.029)	(0.009)
Lagged log(# Score Sends)	–	0.183***	0.186***	0.101*	0.139***	− 0.029**
	–	(0.037)	(0.066)	(0.060)	(0.041)	(0.015)
Competitor lagged log(# Score Sends)	–	0.006	0.063*	− 0.018	− 0.017	− 0.001
	–	(0.011)	(0.035)	(0.023)	(0.019)	(0.005)
Observations	4274	3669	3666	3661	3646	3257
R-squared	0.469	0.182	0.252	0.422	0.184	0.017

Notes: Standard errors are in parentheses and clustered at the college level. *** means significant at 1% level, ** at 5%, and * at 10%. All regressions have college and year fixed effects. All regressions also control for time varying college controls, including: dummies for application fee waiver, early admissions, and SAT or ACT required, as well as linear application deadline relative to January 1st, instate tuition, out of state tuition, and 25th and 75th percentile of math and verbal SAT scores among matriculants and also time varying state controls including: high school graduating cohort size, number of SAT takers, and average SAT score.

the results. Rational substitution of applications to competitor colleges suggests that students are sophisticated enough to calculate the expected utility of two colleges' applications and arrive at answers that are within a few utils ($10) of one another. It seems a more likely explanation is that the $10 fees represent immediate and salient costs that students are averse to paying, despite the relative utilities of the colleges. Reduction in total applications, which we find some evidence of in response to essay requirements, is also consistent with suboptimal behavior in light of the very high marginal benefits of applying to additional colleges (Pallais, 2013; Smith, 2013).

From an institutional perspective, there are several points of note. In the context of application essays, the additional personnel needed to evaluate applications for admission may not be justifiable in light of the fact that these screens appear to contribute little to "molding" of the first year class. This may be due in part to effective screening mechanisms already in place, conditional on applying. However, if attracting Black and Hispanic students is high priority, these small changes do appear to impact their enrollment numbers. More generally, the results suggest that in this educational context, if colleges are to change the quality or composition of students and they, may have to adopt more effective screening mechanisms than essays or application fees.

Appendix

Tables A1 and A2.

References

Autor, D. (2001). Wiring the labor market. *Journal of Economic Perspectives*, 15(1), 25–40.

Bagwell, K., & Riordan, M. (1991). High and declining prices signal product quality. *American Economic Review*, 81(1), 224–239.

Bertrand, M., & Mullainathan, S. (2004). Are emily and greg more employable than lakisha and jamal? A field experiment on labor market discrimination. *American Economic Review*, 94(4), 991–1013.

Bettinger, E. P., Long, B. T., Oreopoulos, P., & Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the H&R Block FAFSA experiment. *Quarterly Journal of Economics*, 127, 1205–1242.

Bound, J., Lovenheim, M., & Turner, S. (2012). Increasing time to baccalaureate degree in the united states. *Education Finance and Policy*, 7(4), 375–424.

Bulman, G. (2013). The effect of access to college assessments on enrollment and attainment. Stanford University manuscript. http://www.stanford.edu/~gbulman/George_Bulman_JMP.pdf

Camerer, C., & Loewenstein, G. (2004). Behavioral economics: Past, present, and future. In C. Camerer, G. Loewenstein, & M. Rabin (Eds.), *Advances in behavioral economics*. Princeton: Princeton University Press.

Cameron, S., & Heckman, J. (1993). The nonequivalence of high school equivalents. *Journal of Labor Economics*, 11(1), 1–47.

Carrell, S. E. and Sacerdote, B. (2013). *Late interventions matter too: The case of college coaching in New Hampshire* (NBER Working Paper, 19031).

Chetty, R., Looney, A., & Kroft, K. (2009). Salience and taxation: Theory and evidence. *American Economic Review*, 99(4), 1145–1177.

Cohodes, S., & Goodman, J. (2014). Merit aid, college quality and college completion: Massachusetts' adams scholarship as an in-kind subsidy. *American Economic Journal: Applied Economics*, 6(4), 251–285.

College Board (2013). Trends in college pricing. *Trends in Higher Education Series*. https://trends.collegeboard.org/sites/default/files/college-pricing-2013-full-report-140108.pdf Accessed online 3/7/14.

Dale, S., & Krueger, A. (2002). Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables. *Quarterly Journal of Economics*, 117(4), 1491–1527.

DellaVigna, S. (2009). Psychology and economics: Evidence from the field. *Journal of Economic Literature*, 47(2), 315–372.

Dillon, E. and Smith, J. (2013). *The determinants of mismatch between students and colleges* (NBER Working Paper).

Dunn, J. (2013). Admissions receives 25,000 applications for class of 2017. *Boston College Chronicle*. http://www.bc.edu/content/bc/publications/chronicle/FeaturesNewsTopstories/2013/top-stories/applications013013.html Accessed online 2/13/13.

Espenshade, T. J., Chung, C. Y., & Walling, J. L. (2004). Admission preferences for minority students, athletes, and legacies at elite universities. *Social Science Quarterly*, 85, 1422–1446.

Finkelstein, A. (2009). E-Z Tax: Tax salience and tax rates. *Quarterly Journal of Economics*, 124(3), 969–1010.

Gibbons, R., & Waldman, M. (1999). Careers in organizations: Theory and evidence. In O. Ashenfelter, & D. Card (Eds.). *Handbook of labor economics: Vol. 3*. Amsterdam: North Holland.

Goodman, S. (2013). Learning from the test: Raising selective college enroll-ment by providing information. *Finance and economics discussion series 2013-69.* Board of Governors of the Federal Reserve System.

Hoover, E. (2013, April 12). Two, three essays? More can mean less. *New York Times.* Education Life.

Hoxby, C., and Avery, C. (2013). *The missing 'one-offs': The hidden supply of high-achieving, low income students* (NBER Working Paper No. w18586).

Hoxby, C., and Turner, S. (2013) *Expanding college opportunities for high-achieving, low income students* (SIEPR Discussion Paper No. 12-014).

Hurwitz, M. (2011). The impact of legacy status on undergraduate admissions at elite colleges and universities. *Economics of Education Review, 30*(3), 480–492.

Hurwitz, M., Smith, J., Niu, S. and Howell, J. (in press). The Maine question: How is four-year college enrollment affected by mandatory college en-trance exams? *Educational Evaluation and Policy Analysis.*

Kiley, K. (2013). *Free apps, inside higher education.* http://www.inside highered.com/news/2013/05/23/reed-college-eliminates-application-fee-increase-applications-low-income-students#sthash.1ckkkImF.TcUn1fTF.dpbs Accessed online 6/20/14.

Klasik, D. (2013). The ACT of enrollment: The college enrollment effects of required college entrance exam taking. *Educational Researcher, 42*(3), 151–160.

Lacetera, N., Pope, D., & Sydnor, J. (2012). Heuristic thinking and limited attention in the car market. *American Economic Review, 102*(5), 2206–2236.

Landergan, K. (2013). BC celebrates its decline in applications. *The Boston Globe.*

Light, A., & Strayer, W. (2000). Determinants of college completion: School quality or student ability? *Journal of Human Resources, 35*(2), 299–332.

Liu, A. Y. H., Ehrenberg, R. and Mrdjenovic, J. (2007). *Diffusion of common application membership and admissions outcomes at American colleges and universities* (NBER Working Paper #13175).

Long, M. (2004). College applications and the effect of affirmative action. *Journal of Econometrics, 121*(1-2), 319–342.

Luca, M., & Smith, J. (2013). Salience in quality disclosure: Evidence from U.S. news college rankings. *Journal of Economics & Management Strategy, 22*(1), 58–77.

Mullainathan, S., & Thaler, R. (2001). Behavioral economics. In N. Smelser, & P. Baltes (Eds.). *International encyclopedia of the social and behavioral sci-ences: Vol. 20* (pp. 1094–1100). Oxford and New York: Oxford University Press.

Oster, E. (2013). *Unobservable selection and coefficient stability: Theory and validation* (NBER Working Paper #19054).

Pallais, A. (2013). *Small differences that matter: Mistakes in applying to college* (NBER Working Paper #19480).

Riggs, H. E. (2011). The price of perception. *The New York Times*, p. ED33.

Smith, J. (2013). The effect of college applications on enrollment. *B.E. Journal of Economic Analysis & Policy, Contributions, 14*(1), 151–188.