For Online Publication: Supplemental Appendix

In this supplemental appendix, we develop a model that explains the applicant's decisions to submit her SAT score, to apply early decision, and, if accepted, to enroll or not at the college. The college's objective function, which determines their acceptance decision, is similar to that in the text and reiterated here.

General Environment

The timeline in Figure 1 depicts the basic environment. The applicant must first choose whether to apply early decision and whether to submit her SATI scores. The applicant makes the choice that maximizes her expected utility **-** knowing that the decision to apply early decision and to submit influences whether she is accepted. In addition, the applicant knows that applying early decision may restrict her opportunities of attending another college.

Conditional on the applicant's early decision and SAT submission decisions, as well as the other information provided on the application, the college decides whether or not to accept the applicant. When making these decisions, the college considers how its acceptance decisions affect the expected "quality" of the current and future student body. An individual student's quality depends on the ability level of the student prior to attending the college and how much value added the college provides through academic quality and demographic diversity, which in turn depends on the composition of the student body. The applicant provides the college with a great deal of information that the college can use to judge these qualities. In the case of an applicant who chooses not to submit an SATI score, the college's expectation of the applicant's quality depends on its inference about her SATI score.

Current acceptance decisions influence future student body quality because they affect the reputation and external ranking of the school. A college's ranking, by organizations such as *U.S. News and World Report*, depends on the quality of the enrolled students, based on measured outcomes like high school performance and standardized test scores. An optional SATI policy potentially influences these ratings because the average SATI score reported to these ranking organizations is based on the scores of students who submit them. During the time of our data, the college's yield rate, defined as the fraction of accepted applicants that choose to enroll, also affected rankings.

If the college accepts the applicant, the applicant then decides whether to enroll. The applicant will choose to enroll if enrolling maximizes her expected utility, which depends on (among other things) the admission decisions of the other colleges the student applied to and financial aid offers.

Applicant's Early Decision and SAT Submission Decisions

A potential student's expected utility from applying is the probability the applicant attends the college times her expected utility from attending plus the probability the applicant does not attend times the expected utility associated with her not attending minus the cost associated with applying.

At the time of applying, we assume a potential student's expected utility conditional on attending the college is

$$\mu(\mathbf{Z_i}, \varepsilon_{ap}, \varepsilon_{en}) = \mu(\mathbf{Z_i}) + \varepsilon_{ap} + \varepsilon_{en}. \qquad [1]$$

The term $\mu(\mathbf{Z_i})$ captures the portion of the individual–specific preferences for attending the college that depends on observable variables, which we denote by the vector $\mathbf{Z_i}$. The variables ε_{ap} and ε_{en} represent unobservable individual–specific preferences for attending the college. The variable ε_{ap} is known to the applicant at the time she submits the application, and captures things such as how well the college's academic curriculum matches the applicant's tastes and whether the college provides an environment conducive to the applicant's interests. The variable ε_{en} is not observed by the person when she submits the application but is known when she makes the enrollment decision. This variable captures things such as financial aid offers and acceptance decisions from other colleges.

The probability the college accepts the applicant and the probability an accepted applicant enrolls will depend not only on the applicant's observable characteristics ($\mathbf{Z_i}$) but also on her decision to apply early decision and submit her SATI scores. The applicant's utility is U_R if the college does not accept the applicant or if the applicant is accepted but chooses not to enroll conditional on the applicant not applying early decision. Because applying early decision can restrict the applicant's outside alternatives, we specify the applicant's utility as U_R–C if she applies early decision and does not enroll.

An applicant incurs a fixed cost associated with applying, such as essays to write and application fees, as well as a cost associated with submitting SATI scores. Both of these costs may vary across applicants. We represent the fixed cost as K and the cost of submitting as ε_s where ε_s is known to the applicant, but not the researcher, at the time of the submission.[1]

Thus, a potential student's expected utility from not applying early decision to the college and submitting her SATI scores is:

$$EP_{ne,s}^{att}[\mu(\mathbf{Z_i}) + \varepsilon_{ap} + E(\varepsilon_{en})]+[1-EP_{ne,s}^{att}][U_R]-K-\varepsilon_s. \qquad [2]$$

where $EP_{ne,s}^{att}$ is the applicant's expectation of the probability she will attend the college and $E(\varepsilon_{en})$ is the expectation of ε_{en}, conditional on attending.[2] Conversely, a potential student's expected utility from applying early decision to the college and submitting her SATI scores is:

$$EP_{e,s}^{att}[\mu(\mathbf{Z_i}) + \varepsilon_{ap} + E(\varepsilon_{en})]+[1-EP_{e,s}^{att}][U_R-C]-K-\varepsilon_s. \qquad [3]$$

The potential student's expected utility associated with not submitting her SATI scores are similar to those in equations [2] and [3] except they do not include ε_s and the probability of enrolling is different.

[1] We refer to ε_s as the cost of submitting but allow this "cost" to be positive or negative. We perceive ε_s, in part, as the processing cost associated with the applicant deciding whether or not to submit her SATI scores instead of strictly the explicit costs of submitting (which are minimal).

[2] For simplicity, we assume that $E(\varepsilon_{en})$ is zero and does not depend on whether she applies early decision or whether she submits her SAT I scores. Based on how we empirically estimate an applicant's expectations of attending the college at the time she applies, this assumption is less of a concern.

When deciding whether to apply early and submit, the potential student maximizes her expected utility. Assuming U_R is zero (a normalization), an applicant applies early decision and does not submit if

$$\varepsilon_s + [EP^{att}_{e,ns} - EP^{att}_{e,s}]\varepsilon_{ap} > [EP^{att}_{e,ns} - EP^{att}_{e,s}][-\mu(\mathbf{Z_i}) - E(\varepsilon_{en}) - C], \quad \{\text{Condition 1}\} \qquad [4]$$

$$[EP^{att}_{e,ns} - EP^{att}_{ne,ns}]\varepsilon_{ap} > [EP^{att}_{e,ns} - EP^{att}_{ne,ns}][-\mu(\mathbf{Z_i}) - E(\varepsilon_{en})] + [1 - EP^{att}_{e,ns}][C] \quad \{\text{Condition 2}\} \qquad [5]$$

and

$$\varepsilon_s + [EP^{att}_{e,ns} - EP^{att}_{ne,s}]\varepsilon_{ap} > [EP^{att}_{e,ns} - EP^{att}_{ne,s}][-\mu(\mathbf{Z_i}) - E(\varepsilon_{en})] + [1 - EP^{att}_{e,ns}][C]. \quad \{\text{Condition 3}\} \qquad [6]$$

Similar inequalities can be derived for when an applicant: (i) applies early and does submit; (ii) does not apply early and does not submit; and (iii) does not apply early and does submit. Assuming $E(\varepsilon_{en})=0$ and imposing certain minor restrictions on the applicant's expectations of enrolling, Figure 2 depicts an applicant's decision of whether to apply early and/or submit her SATI scores, and how these decisions depend on ε_{ap} and ε_s.[3]

College's Acceptance Decision

Based on the college's objective function stipulated in the paper, the college accepts applicant *i* if:

$$EP^{en}_{k,s}\,[\Pi^P(\mathbf{SAT_{+i}^P},\mathbf{Z_{+i}^P}) + \varepsilon_{qi} + \Pi^R(\mathbf{SAT_{+i}^R},\mathbf{Z_{+i}^R}) + \Pi^D(\mathbf{Z_{+i}^D})] + (1 - EP^{en}_{k,s})[\Pi^P(\mathbf{SAT_{-i}^P},\mathbf{Z_{-i}^P}) + \Pi^R(\mathbf{SAT_{-i}^R},\mathbf{Z_{-i}^R}) + \Pi^D(\mathbf{Z_{-i}^D})] + f(YR_{ai}) > \Pi^P(\mathbf{SAT_{-i}^P},\mathbf{Z_{-i}^P}) + \Pi^R(\mathbf{SAT_{-i}^R},\mathbf{Z_{-i}^R}) + \Pi^D(\mathbf{Z_{-i}^D}) + f(YR_{ri}) \qquad [7]$$

where $EP^{en}_{k,s}$ denotes the expected probability an accepted applicant *i* enrolls where *k* equals *e* (*ne*) if applicant *i* applied early decision (regular decision) and *s* denotes that applicant *i* submitted her SATI score. The other notation corresponds to that in the paper and the rational for this specification is provided in the paper. Modeling the college's acceptance decision in this manner results in a cutoff SATI score for an applicant who submits where, conditional on the applicant's observables and unobservables, the college accepts the

[3] Figure 2 is based on the premise that the applicant's expected probability of being accepted and enrolling is greater if she applies early and does not submit. If this is not the case, the regions in Figure 2 would change in the obvious manner.

applicant only if her SATI score is above the cutoff. In a similar manner for applicants who chose not to submit, a cutoff inferred SATI score exists where the college accepts the applicant only if the inferred SATI score is above the cutoff.

Applicant's Enrollment Decision

An accepted applicant will enroll in the college if enrolling maximizes her expected utility. Based on normalizing the applicant's utility of enrolling in another college (or not enrolling at any college) to zero if the applicant does not apply early decision and specifying the expected utility conditional on attending the college as $\mu(\mathbf{Z_i}, \varepsilon_{ap}, \varepsilon_{en}) = \mu(\mathbf{Z_i}) + \varepsilon_{ap} + \varepsilon_{en}$, an applicant who does not apply early decision will enroll in the college if $\varepsilon_{ap}+\varepsilon_{en} > -\mu(\mathbf{Z_i})$. As stated earlier, ε_{ap} is known to the applicant at the time she submits the application and ε_{en} is not observed by the person when she submits the application but is known when she makes the enrollment decision. Because the utility of not enrolling in the college for an applicant that applies early decision is -C, an applicant who applies early decision will enroll if $\varepsilon_{ap}+\varepsilon_{en} > -\mu(\mathbf{Z_i})$-C.

The probability of enrolling will depend on the applicant's early decision and submission selections because these decisions depend on ε_{ap}. Conditional on being accepted, the probability an early decision applicant who does not submit enrolls is

$$P^e(\mathbf{Z_i},e,ns)=\text{Prob}[\ \varepsilon_{ap}+\varepsilon_{en}>-\mu(\mathbf{Z_i})-C \mid e,ns]. \qquad [8]$$

Using Bayes Rule, this conditional probability is just the probability the applicant applies early decision, does not submit and enrolls (i.e., $\varepsilon_{ap}+\varepsilon_{en}>-\mu(\mathbf{Z_i})$-C and Conditions 1, 2 and 3 are satisfied) divided by the probability the applicant applies early decision and does not submit (Conditions 1, 2 and 3 are satisfied). The probability of enrolling for an applicant who applies early and submits is similar except for the appropriate changes in Conditions 1, 2 and 3. The corresponding Conditions also apply to the probability an applicant who does not apply early chooses to enroll except the applicant does not incur the cost associated with applying early decision if she does not enroll in the college (i.e., C=0).

Parametric and Functional Form Assumptions

We construct and estimate a likelihood function in this section by: (1) parameterizing the college's inference for those applicants who do not submit SATI scores; (2) making assumptions about the applicants' expectations of attending ($EP_{k,l}^{att}$), the applicants' expectations of ε_{en} conditional on attending, and the college's expectations of enrollment ($EP_{k,l}^{en}$); (3) imposing functional form restrictions on the college's and applicants' objective functions; and (4) making distributional assumptions for the random components.

We parameterize the college's belief of applicant *i*'s SAT score if she does not submit in a similar manner as in the paper. We assume that the college's belief of applicant *i*'s SAT score if she does not submit is $\chi\,\mathbf{SAT_{i,un}} + (1-\chi)\mathbf{SAT_{i,cond}}$ where $\mathbf{SAT_{i,un}}$ =g($\mathbf{Z_i}$|submit)+ε_{un} and $\mathbf{SAT_{i,cond}}$ = SAT_i.[4]

Along with parameterizing the college's inference, we must also specify how the applicants and college form acceptance and enrollment expectations. Specifically, applicants likely form their expectations of acceptance and enrollment as first time college applicants without experience in the process. When applying to the college, an applicant is unlikely to understand exactly how the decisions to apply early and submit SATI scores will affect the probability of her acceptance and enrollment. However, because of the extensive popular press coverage of the process, an applicant is likely to understand that applying early decision significantly increases her probability of acceptance and her probability of attending. Given this environment and computational constraints, we assign the applicant's expectation of how applying early increases the probability of attending as the average difference between the attendance rates of early decision applicants and regular decision applicants for all students.[5]

[4] The likelihood had difficulty converging when we specified $\mathbf{SAT_{i,cond}}$ equal to $SAT_i+\varepsilon_{cond}$ where $\varepsilon_{cond}\sim N(0,\sigma_c^2)$. To facilitate convergence, we specify $\mathbf{SAT_{i,cond}}$ = SAT_i. The estimates do not change appreciably if we assume $\mathbf{SAT_{i,cond}}=SAT_i+\varepsilon_{cond}$, $\varepsilon_{cond}\sim N(0,\sigma_c^2)$ and specify reasonable values for σ_c.

[5] For College X (College Y), the probability an early decision applicant attends is 0.825 (0.586) and the probability a regular admission applicant attends is 0.084 (0.086). Therefore, the expression [1 −

An applicant's impression of how submitting her SATI score affects her probability of attending is difficult to access. It obviously depends on her SATI score but is also likely affected by her other academic performance measures and demographic characteristics. Instead of modeling these expectations, we allow the applicants' submission decisions to inform us of these expectations. This is done by specifying the applicants' expectation of how submitting changes the probability of attending ($EP^{att}_{k,ns}$ - $EP^{att}_{k,s}$ for k={e,ne}) as

$$[.5\exp(\boldsymbol{\beta}^{S}\bullet\mathbf{Z_i}^{S})-.5]/[\exp(\boldsymbol{\beta}^{S}\bullet\mathbf{Z_i}^{S})+1].$$

The functional form selected for the change in expected probability associated with the decision to submit ensures that it lies between -.5 and .5.[6] The vector $\mathbf{Z_i}^{S}$ contains observable applicant characteristics including private high school, female, high school gpa, class rank, income, legacy, white, and Northeast region indicators.

Unlike students, the colleges' admission departments have extensive prior experience observing enrollment decisions. Therefore, we assume the college uses the information they have on each applicant to accurately predict their enrollment probabilities. If this is the case, than the college's expectation of the probability of enrolling for those applicants that submit their SATI, SATII and ACT scores would be the same as the predicted probability: $EP^{en}_{k,l}$ $=P^e(\mathbf{Z},k,l)$ for k={e,ne} and l={s,ns}. For applicants who chose not to submit their SATI scores, the college's expected probability of enrollment is similar to the predicted probability except the college infers an SATI score of $\chi\,\mathbf{SAT_{i,un}}+(1-\chi)\mathbf{SAT_{i,cond}}$ while the predicted probability, $P^e(\mathbf{Z_i},k,l)$, is based on the actual score. For applicants who took an SATII exam and/or the ACT exam but did not submit the score(s), the predicted probability of enrolling is based on the actual score(s) while the college's expectation of enrollment is based on the actual score only if it is submitted.

$EP^{att}_{e,ns}]/[EP^{att}_{e,ns} - EP^{att}_{ne,ns}]$ in Condition 2 would equal 0.236 for College X and 0.828 for College Y. Our empirical results are robust to changes in these values.

[6] We chose the functional form to restrict this change in the expected probability to between -.5 and .5, instead of -1 and 1, for computational reasons. We do not expect this restriction to bind for any applicant.

To obtain a likelihood function, we not only parameterize how the colleges infer SATI scores for those who do not submit and how the applicants and colleges form their expectations, but must also impose functional form restrictions on the colleges' and applicants' objective functions. In a similar manner as in the paper, we assume that for each applicant *i*:

$$g(\mathbf{Z_i}|\text{submit}) = \boldsymbol{\alpha}\bullet\mathbf{Z_i}|\text{submit} \;\; , \;\; \mu(\mathbf{Z_i}) = \boldsymbol{\beta^{\mu}}\bullet\mathbf{Z_i}$$

$$f(YR_{ai}) = \beta^{YR}\, YR_{ai} \quad , \quad f(YR_{ri}) = \beta^{YR}\, YR_{ri} \qquad [9]$$

$$\Pi^P(\mathbf{SAT_{+i}^P},\mathbf{Z_{+i}^P}) = \beta^P_{SAT}SAT_{+i}^P + \boldsymbol{\beta^P}\bullet\mathbf{Z_{+i}^P} \;\; , \;\; \Pi^P(\mathbf{SAT_{-i}^P},\mathbf{Z_{-i}^P}) = \beta^P_{SAT}SAT_{-i}^P + \boldsymbol{\beta^P}\bullet\mathbf{Z_{-i}^P}$$

$$\Pi^R(\mathbf{SAT_{+i}^R}\ \mathbf{Z_{+i}^R}) = \beta^R_{SAT}SAT_{+i}^R + \boldsymbol{\beta^R}\bullet\mathbf{Z_{+i}^R} \;\; , \;\; \Pi^R(\mathbf{SAT_{-i}^R},\mathbf{Z_{-i}^R}) = \beta^R_{SAT}SAT_{-i}^R + \boldsymbol{\beta^R}\bullet\mathbf{Z_{-i}^R}$$

$$\Pi^D(\mathbf{Z_{+i}^D}) = \boldsymbol{\beta^D}\bullet\mathbf{Z_{+i}^D} \;\; \text{and} \;\; \Pi^D(\mathbf{Z_{-i}^D}) = \boldsymbol{\beta^D}\bullet\mathbf{Z_{-i}^D}.$$

These functional form assumptions allow us to relate, in a straightforward manner, the probability the college accepts applicant *i* to her observables if we assume that the college's expectations of the characteristics and size of the student body, as well as the number of applicants accepted and the college's yield rate, do not vary across applicants.[7] These details are contained in the paper's appendix.

Along with the functional form assumptions, we make distributional assumptions for ε_{ap}, ε_{en}, ε_{qi}, ε_s, and ε_{un} that facilitate estimation of the likelihood function. We assume that the population distributions are independent, ε_{ap}, ε_{en}, ε_{qi}, ε_s ~N(0,1) and ε_{un}~N(0,σ_u^2).

Likelihood Function

Given the assumptions discussed above, we are able to estimate a vector of structural parameters $\boldsymbol{\theta} = \{\chi, \beta^{P'}_{SAT}, \beta^{R'}_{SAT}, \boldsymbol{\alpha}, \sigma_u, \beta^{int}, \boldsymbol{\beta^{\mu}}, \boldsymbol{\beta^{P'}}, \boldsymbol{\beta^{R'}}, \boldsymbol{\beta^{D'}}, \beta^{YR'}, \boldsymbol{\beta^{S}}$ and C$\}$ by constructing a likelihood function based on the applicant's decisions to apply early decision, to submit her SATI scores and, conditional on being accepted, to enroll, as well as the college's acceptance

[7] We include an early decision indicator variable in the $\boldsymbol{\beta^P}$ and $\boldsymbol{\beta^R}$ vectors because there may be applicant attributes correlated with the early decision variable which the college observes but we do not. Besides the estimate of β^{YR}, the other parameter estimates do not change significantly if the early decision indicator is not included in these vectors. These results are available from the authors.

decision. Specifically, our model permits us to derive parametric expressions, as a function of observed data and structural parameters, for the probabilities an applicant applies early decision and/or submits her SATI score, the probability the college accepts an applicant and the probability an applicant enrolls.

When specifying the likelihood function, we denote the applicant applying early decision, the applicant submitting SATI score, the college's acceptance decision and the applicant enrolling by indicator variables y_{ed}, y_s, y_a, and y_{en}, respectively. We also denote the probabilities associated with applicant *i*'s decisions whether to apply early and submit as $P^{k,l}(\mathbf{Z_i,\theta})$, the probability the college accepts applicant *i* as $P^a(\mathbf{Z_i},\boldsymbol{\theta},k,l)$ and the probability an accepted applicant *i* enrolls as $P^e(\mathbf{Z_i},\boldsymbol{\theta},k,l)$; where *k* equals *e* (*ne*) if the applicant applies early decision (regular decision) and where *l* equals *s* (*ns*) if the applicant submits (does not submit). As in the paper, P_{sat} is the probability the applicant obtains a score of SAT_i. With this notation, applicant *i*'s contribution to the likelihood function is

$$\prod P^{e,s}(\mathbf{Z_i,\theta})^{y_{ed}\,y_s}\, P^{ne,s}(\mathbf{Z_i,\theta})^{(1-y_{ed})y_s}\, P^{e,ns}(\mathbf{Z_i,\theta})^{y_{ed}(1-y_s)}\, P^{ne,ns}(\mathbf{Z_i,\theta})^{(1-y_{ed})(1-y_s)}$$
$$P^a(\mathbf{Z_i},\boldsymbol{\theta},k,l)^{y_a}\,[1-P^a(\mathbf{Z_i},\boldsymbol{\theta},k,l)]^{(1-y_a)}\, P^e(\mathbf{Z_i},\boldsymbol{\theta},k,l)^{y_a y_e}\,[1-P^e(\mathbf{Z_i},\boldsymbol{\theta},k,l)]^{y_a(1-y_e)}\,(P_{sat})^{y_s}.$$

Applicant *i* will apply early decision and not submit her SATI scores if Conditions 1, 2 and 3 are satisfied. As the result of our assumption on how the applicant's expectation of applying regular admission affects her probability of attending, Condition 3 does not bind. Given our functional form assumption that $\mu(\mathbf{Z_i}) = \boldsymbol{\beta}^{\mu}\bullet\mathbf{Z_i}$ and $EP^{att}_{k,ns} - EP^{att}_{k,s} = [.5\exp(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)-.5]/[\exp(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)+1]$ for $k=\{e,ne\}$, which we denote as $f(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)$, we can restate Conditions 1 and 2 as

$$\varepsilon_s/f(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)+\varepsilon_{ap} \gtrless -\boldsymbol{\beta}^{\mu}\bullet\mathbf{Z_i}-C \text{ if } \boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S \gtrless \mathbf{0} \text{ and } \varepsilon_{ap} > -\boldsymbol{\beta}^{\mu}\bullet\mathbf{Z_i} + [1-EP^{att}_{e,ns}][C]/f(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S).$$

The assumptions that ε_s and ε_{ap} are standard normally distributed results in $\varepsilon_s/f(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)+\varepsilon_{ap}$ being normally distributed with mean zero and variance $1+1/f(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)^2$. The assumption that ε_s and ε_{ap} are independent results in $(\varepsilon_s/f(\boldsymbol{\beta}^S\bullet\mathbf{Z_{-i}}^S)+\varepsilon_{ap}, \varepsilon_{ap})$ having a cdf of a standard bivariate normal random variables with correlation $1/[1+1/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)^2]^{.5}$. Thus, we obtain a bivariate normal distribution for $P^{e,ns}(\mathbf{Z_i}, \boldsymbol{\theta})$ and similar bivariate normal distributions can be constructed for $P^{e,s}(\mathbf{Z_i}, \boldsymbol{\theta})$, $P^{ne,ns}(\mathbf{Z_i}, \boldsymbol{\theta})$ and $P^{ne,s}(\mathbf{Z_i}, \boldsymbol{\theta})$.

An accepted applicant will enroll when $\varepsilon_{ap}+\varepsilon_{en}>-\mu(\mathbf{Z_i})-C$ if she applied early decision and when $\varepsilon_{ap}+\varepsilon_{en}>-\mu(\mathbf{Z_i})$ if she chose not to apply early decision. Based on these enrollment decisions, applicant *i* applies early decision, does not submit her SAT1 scores and enrolls (conditional on being accepted) if $\varepsilon_{ap}+\varepsilon_{en}>-\boldsymbol{\beta}^{\mu} \bullet \mathbf{Z_i}-C$ and the inequalities above representing Conditions 1 and 2 are satisfied. The assumptions that ε_{ap}, ε_{en} and ε_s are standard normally distributed and independent allows the probability applicant *i* applies early decision, does not submit her SAT1 scores and enrolls (conditional on being accepted) to be represented by a trivariate normal probability distribution. When constructing this distribution note that $\varepsilon_s/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)+\varepsilon_{ap}$ has a mean of zero with a variance of $1+1/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)^2$ and $\varepsilon_{ap}+\varepsilon_{en}$ has a mean of zero with a variance of 2. Also note that $(\varepsilon_s/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)+\varepsilon_{ap}, \varepsilon_{ap})$ has a correlation of $1/[1+1/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)^2]^{.5}$, $(\varepsilon_s/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)+\varepsilon_{ap}, \varepsilon_{ap}+\varepsilon_{en})$ has a correlation of $1/[2+2/f(\boldsymbol{\beta}^S \bullet \mathbf{Z}_{-i}^S)^2]^{.5}$ and $(\varepsilon_{ap}, \varepsilon_{ap}+\varepsilon_{en})$ has a correlation of $1/[2]^{.5}$. Therefore, $P^e(\mathbf{Z_i},\boldsymbol{\theta},e,ns)$, the probability an accepted applicant *i* enrolls conditional on her decisions to apply early and not submit her SAT1 scores, is just the probability from the trivariate normal distribution divided by the probability from the bivariate normal distribution mentioned above (i.e., $P^{e,ns}(\mathbf{Z_i},\boldsymbol{\theta})$). Similar conditional distributions can be constructed for $P^e(\mathbf{Z_i},\boldsymbol{\theta},e,s)$, $P^e(\mathbf{Z_i},\boldsymbol{\theta},ne,ns)$, and $P^e(\mathbf{Z_i},\boldsymbol{\theta},ne,s)$.

We obtain the likelihood function, $L(\boldsymbol{\theta})$, by inserting $P^{k,l}(\mathbf{Z_i},\boldsymbol{\theta})$, $P^a(\mathbf{Z_i},\boldsymbol{\theta},k,l)$, $P^e(\mathbf{Z_i},\boldsymbol{\theta},k,l)$ and P_{sat} into applicant *i*'s contribution to the likelihood function and taking the product across all applicants.[8] Because most statistical packages, including STATA, have the cdf of a standard normal distribution and the cdf of a multivariate standard normal distribution built in, we are able to estimate the structural parameters using simulated

[8] $P^a(\mathbf{Z_i},\boldsymbol{\theta},e,s)$ and $P^a(\mathbf{Z_i},\boldsymbol{\theta},ne,s)$ are equivalent to P_s^a in equation [3] of the paper while $P^a(\mathbf{Z_i},\boldsymbol{\theta},e,ns)$ and $P^a(\mathbf{Z_i},\boldsymbol{\theta},e,ns)$ are equivalent to P_{ns}^a in equation [5] of the paper.

maximum likelihood. The following table contains our estimates of the structural parameters (where SATI and SATII scores are in 100's).

Estimates of Structural Parameters for College X and College Y

Parameter Estimates	College X				College Y			
χ , weight on expected SATI score not conditioning on submission choice	0.262 (0.182)				0.349** (0.088)			
$\beta^{YR'}$, coefficient associated with yield rate in college's objective function	0.0003 (0.001)				0.007 (0.007)			
C , cost associated with restricting alternative options by applying early decision	-1.230** (0.179)				-2.158** (0.310)			
σ_u , standard deviation associated with inference of unconditional SATI score	0.084** (0.001)				0.117** (0.002)			
	Enroll β^{μ}	Accept $\beta^{P'}, \beta^{R'}, \beta^{D}$	Predicted SATI α's	Submit β^{S}	Enroll β^{μ}	Accept $\beta^{P'}, \beta^{R'}, \beta^{D}$	Predicted SATI α's	Submit β^{S}
SATI Score	-0.253** (0.023)			2.296** (0.352)	-0.167** (0.027)			0.444** (0.149)
Submitted SATI Score		0.274** (0.025)				0.658** (0.033)		
Inferred SATI Score		0.300** (0.025)				0.688** (0.034)		
SATII Score(s) available (1=yes)	-0.317 (0.275)				0.365 (0.345)			
Average SATII Score (when available)	0.061 (0.045)				-0.027 (0.057)			
SATII Score(s) Submitted (1=yes)		-2.613** (0.280)	-0.737** (0.013)			-1.777** (0.468)	-0.742** (0.035)	
Ave. SATII Score (when submitted)		0.442** (0.044)	0.123** (0.002)			0.272** (0.073)	0.124** (0.005)	
ACT Score available (1=yes)	-1.321** (0.401)							
Average ACT Score (when available)	0.060** (0.015)							
ACT Score Submitted (1=yes)		-1.269** (0.423)	-0.658** (0.024)					
Average ACT Score (when submitted)		0.053** (0.015)	0.024** (0.001)					
Attended Private HS	-0.062 (0.047)	0.127** (0.039)	0.001 (0.002)	-0.716 (0.522)	-0.034 (0.057)	0.204** (0.055)	0.012** (0.005)	-1.700** (0.620)
Female Student	-0.076 (0.046)	-0.510** (0.039)	-0.021** (0.002)	-0.825 (0.661)	-0.060 (0.052)	0.334** (0.052)	-0.031** (0.005)	-0.630 (0.481)

Standard errors in parentheses: * significant at 5% and ** significant at 1%.

Estimates of Structural Parameters for College X and College Y (cont.)

	College X				College Y			
	Enroll	Accept	Predicted SATI	Submit	Enroll	Accept	Predicted SATI	Submit
No High School GPA reported (sr)	-0.034	0.464**	0.018**	0.169	-0.123	0.501**	0.062**	-2.084
	(0.078)	(0.070)	(0.004)	(1.068)	(0.096)	(0.103)	(0.009)	(7.284)
HS GPA A or A+ (sr)	-0.054	0.896**	0.026**	-1.779	-0.099	0.855**	0.078**	-1.738
	(0.091)	(0.079)	(0.005)	(0.973)	(0.113)	(0.118)	(0.010)	(7.068)
HS GPA A- (sr)	-0.137	0.681**	0.026**	-1.339	-0.147	0.666**	0.058**	-3.224
	(0.080)	(0.070)	(0.004)	(0.868)	(0.104)	(0.110)	(0.009)	(7.001)
HS GPA B+ (sr)	0.045	0.452**	0.016**	-0.514	0.009	0.485**	0.042**	-3.858
	(0.076)	(0.070)	(0.004)	(0.977)	(0.099)	(0.108)	(0.009)	(7.030)
Class rank missing	0.165**	0.133**	0.010**	-0.190	-0.060	-0.050	0.026**	0.087
	(0.058)	(0.048)	(0.003)	(0.808)	(0.068)	(0.064)	(0.006)	(0.590)
Class rank 1st 10th	0.056	0.421**	0.023**	-1.241	-0.174	0.428**	0.069**	-0.789
	(0.083)	(0.066)	(0.004)	(1.025)	(0.104)	(0.099)	(0.009)	(0.808)
Class rank 2nd 10th	0.236**	0.227**	0.009*	0.511	-0.028	0.002	0.024**	37.642
	(0.070)	(0.060)	(0.004)	(0.885)	(0.095)	(0.095)	(0.009)	(.)
Income Missing (sr)	0.047	0.150**	-0.006	-0.967	-0.040	0.075	-0.006	0.026
	(0.061)	(0.050)	(0.003)	(0.702)	(0.075)	(0.073)	(0.007)	(0.646)
Income <100K (sr)	0.048	0.155**	-0.013**	0.859	-0.066	-0.237**	-0.042**	0.003
	(0.059)	(0.049)	(0.003)	(0.764)	(0.080)	(0.079)	(0.007)	(0.715)
Legacy (1=yes)	0.353**	0.747**	0.006	-0.238	0.296**	0.313**	-0.006	-0.455
	(0.124)	(0.121)	(0.007)	(1.549)	(0.099)	(0.105)	(0.009)	(0.997)
White	0.278**	-0.715**	0.050**	-8.764**	0.377**	-1.474**	0.081**	-0.196
	(0.074)	(0.057)	(0.004)	(2.634)	(0.092)	(0.090)	(0.007)	(0.824)
Not from Northeast	-0.113*	0.004	0.001	0.948	-0.204**	0.176**	0.007	-0.470
	(0.054)	(0.043)	(0.003)	(0.810)	(0.076)	(0.068)	(0.006)	(0.548)
Apply Early Decision		1.795**	-0.013**			1.179**	-0.042**	
		(0.086)	(0.005)			(0.093)	(0.007)	
Constant	1.301**	-3.950**	1.189**	-12.91**	0.697*	-8.232**	1.124**	1.073
	(0.288)	(0.310)	(0.006)	(3.29)	(0.316)	(0.392)	(0.011)	(7.117)
	-3,544				-3,851			
	6,557				3,602			

Standard errors in parentheses: * significant at 5% and ** significant at 1%.

FIGURE 1
Timeline of Decisions

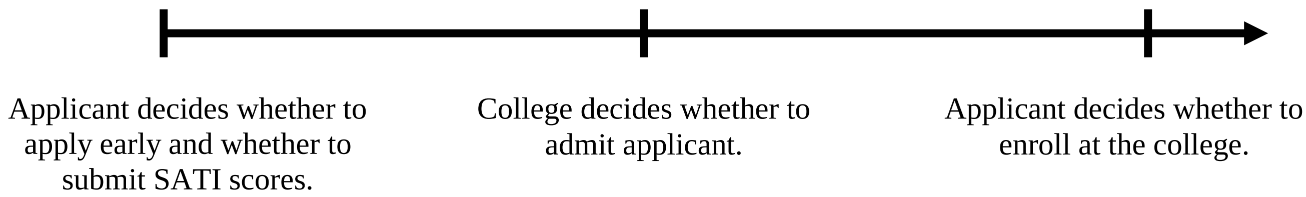

FIGURE 2
Applicant's Decision to Apply Early and Submit SATI Scores