Modeling preferential admissions at elite liberal arts colleges

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Abstract

This paper presents the results of a model that simulates the effects of varying preferential admissions policies on the academic profile of a set of 35 small liberal arts colleges. An underlying assumption is that all schools in the set use the same ratio of preferential to non-preferential admissions. The model predicts that even drastic changes in this ratio have little effect on these institutions' comparative academic profile, as measured by the mean SAT score of the incoming class. When preferential admissions rates are altered, admissions numbers must be altered as well to achieve a desired class size; the model predicts that these changes effectively cancel each other out.

Keywords: preferential admissions; liberal arts colleges

Admission preferences have received much attention in the past several years. Beyond academic merit (e.g. standardized test scores, high school GPA), college admissions offices use complex paradigms to create student bodies that represent a balance of diverse talents and backgrounds and provide the institution with historical continuity and resource support. These preferences, however, have come under increased scrutiny. Opponents of affirmative action have questioned the use of ethnicity and race in college admissions. Others have questioned preferences for legacies (e.g. children of alumni) and athletes at elite institutions, especially in the context of reduced opportunities for lower socio-economic applicants (Golden, 2006; Bowen, Kurzweil & Tobin, 2005). Strict use of academic merit, however, is one-dimensional and not always equitable, since it doesn't acknowledge the diversity of backgrounds and opportunities among applicants (Hurwitz, 2011). This paper presents the results of a model that simulates the effects of different rates of preferential admissions on the academic profile of a set of 35 elite liberal arts colleges in the United States, as measured by the mean SAT scores of each school's incoming class. The model assumes that these institutions all use the same level of preferential admissions; thus, it simulates the effect on this group of institutions as a whole, rather than considering the effect of different schools implementing different preferential admissions policies. The model predicts that even drastic changes in the weight accorded to non-academic factors in the admissions decision process have remarkably little effect on these institutions' comparative academic profile. When preferential admissions rates are altered, admissions numbers must be altered as well to achieve a desired class size; the model predicts that these changes effectively cancel each other out.

LITERATURE REVIEW

There has been a recent wave of research addressing the impact of preferences in the admission process. William Bowen and various colleagues have looked at the consequences and benefits of using race, athletics, and legacy status to make admission decisions. Bowen and Bok, in *The Shape of the River* (1998), make a case that preferential admission based on race has benefitted the students and society in general. Shulman and Bowen, in *The Game of Life* (2001) and Bowen and Levin, in *Reclaiming the Game* (2003), respectively, document the advantages athletes receive in the admission process and the degree to which they underperform in the classroom at elite institutions. In *Equity and Excellence*, Bowen, Kurzweil and Tobin (2005) contend that the advantage applicants receive in regard to race, athletics, and legacy status comes at the cost of socio-economic diversity. As a body of work, the research of Bowen et al. demonstrates that preferential admissions serve different purposes, for both society and the institution, but are fraught with political complexities and inequities. Many of these discussions and studies have informed, or been driven by, the 2003 U.S. Supreme Court ruling in Grutter v. Bollinger (2003), which addressed affirmative action programs at the University of Michigan. In its decision, the Court stated that the use of race in admissions decisions furthers a compelling interest in obtaining the educational benefits that flow from a diverse student body. The Court stated that "no acceptance or rejection is based automatically on a variable such as race and that this process ensures that all factors that may contribute to diversity are meaningfully considered alongside race" (The Oyez Project, 2002); thus, in the words of Justice O'Connor, a "race-conscious admissions program does not unduly harm nonminority applicants." (Grutter v. Bollinger, 2003).

While the philosophical underpinnings and outcomes of preferential admissions have been defined and analyzed by the Supreme Court, Bowen (Bowen et al., 2005), and others (Golden, 2006; Orfield, 1999), very few attempts have been made to model the impact of changing current admission policies. Espenshade, Chung and Walling (2004) attempted to quantify the level of preference given to race, recruited athletes, and legacies at three highly competitive universities. Overall, African-American candidates received the equivalent of 230 extra SAT points, recruited athletes gained 200, Hispanics gained 185 points, and legacies received 160 points. On the downside, Asian-American applicants actually lost 50 points. In a follow-up study, Espenshade and Chung (2005) modeled the effects of changing preferences among the three primary categories. Through simulation, they found that eliminating preference by race would substantially decrease the number of admitted African-American and Hispanic applicants, while increasing the number of admitted Asian-American applicants. On the other hand, their model predicted that preferences for athletes and legacies, who are predominately white, have a less dramatic effect on underrepresented groups. In his study on the impact of legacy admits at 30 elite institutions, Hurwitz (2011) developed a model using conditional logistic regression that suggested that legacy applicants are more than three times as likely to be admitted than non-legacies.

The philosophical debates and research done to this point, however, do not fully consider the complexity of the entire admissions process. Multiple preferences come into play in developing a class at any single institution. The big three preferences of race, athletic recruitment and legacy are most debated and researched, but other preferences can play a smaller though still significant role, such as musical or other artistic ability, as well as special life circumstances and achievements. As noted by Hurwitz (2011), it is impossible to create a rank-order of applicants based on a composite of academic and non-academic characteristics. Higher SAT scores and secondary grades are correlated with a higher likelihood of being admitted, but many other factors enter into admissions decisions. The purpose of the model presented in this paper is to attempt to strip away those factors and explore the effects of varying levels of preferential admissions on the comparative academic profile of a group of selective liberal arts colleges.

DESCRIPTION OF THE MODEL

The model starts with a set of elite schools, each wanting to matriculate an incoming class, and a set of students, each wanting to go to one of these schools. The aim is to draw conclusions about the top 35 liberal arts colleges, but it is crucial to note at the outset that 50 schools are included in the model because students applying to the top 35 schools will most likely also apply to one or more 'safety schools'. To reflect the current popularity of early decision (ED) admissions, the model includes a simulation of one ED round (in which students apply to only one school and must accept an offer at that school if they are admitted), which is then followed by a regular round later in the academic year. In each round, the model simulates three processes:

- students apply to a set of schools;
- schools admit a subset of their applicant pool;
- students deposit (*i.e.* accept an offer) at a school offering them admission, if any.

To simulate the admissions decision process, a number of simplifying assumptions are made. First, in each round, a fixed percentage of admission decisions are non-preferential, in that they are based purely on academic merit, which, for simplicity, is measured solely by SAT scores. The remaining preferential admission decisions take into consideration a variety of other factors, which could include race, athletic ability or legacy status; however, as mentioned earlier, the model does not distinguish among these factors. Second, in each round, the percentage of decisions which are preferential (hereafter referred to as the *preferential rate*) is the same for all schools in the model; that is, there is a common ED-round preferential rate, which we denote P_{ED}, and a common regular-round preferential rate, P_{REG}. A third assumption is that if a school admits n applicants non-preferentially and p applicants preferentially (in either round), it first admits students having the top n SAT scores in its applicant pool, and then admits p students chosen randomly and uniformly from the remainder of the pool (assuming they meet the school's minimum cut-off SAT score).

Obviously, no admissions office would use such a procedure to create an incoming class. However, the reasonableness of these assumptions (and others, detailed below) can be tested by verifying the model's ability to simulate various defining features of the status quo, that is, to create a set of incoming classes resembling those of the actual 2010 incoming classes at a set of 35 elite liberal arts colleges. These 35 institutions were chosen using data from the Integrated Postsecondary Education Data System's Institutional Characteristics Survey (IC) (U.S. Department of Education, 2010). First, women's colleges and military academies are eliminated from consideration to ensure a common applicant pool. The top 35 liberal arts institutions are selected based on the mean SAT score of the incoming class (estimated by averaging the 25-th and 75-th percentile scores in the critical reading and math portions of the SAT). Ties are broken in this SAT-ranking by considering acceptance rate (defined as the total number of admits divided by the total of applicants, over both the ED and regular rounds); schools with lower acceptance rates are ranked higher. The resulting rankings differ somewhat from the *US News and World Report* rankings, which take into account many other factors. However, the ultimate purpose is to investigate how varying the preferential rates affects the academic profile of the incoming class as measured only by its mean SAT score. See Table 1 (Appendix) for some data summarizing the academic profiles of this set of schools, compiled from IPEDS IC 2010 data (U.S. Department of Education, 2010), as well as the *US News and World Report* rankings (US News and World Report, 2011). (Yield is defined as the total number of deposits divided by the total number of admits, again over both the ED and regular rounds.)

Calibrating the parameters in the model so that it could reasonably simulate the status quo as shown in Table 1 (Appendix) involved considerable experimentation. If one run of the program under a given set of parameter values produced promising outputs, the program was run 20 times and the parameters were averaged, to test robustness. To justify the ultimate choice of parameter values, some comparisons between IC 20101 data and 20-run average simulation results are presented below.

Table 1 (Appendix) shows that there is significant variation in size among the schools in our set of 35 elite institutions, in terms of total number of applications, admits and deposits; however, there is much less variation in acceptance rates and yields. In the model, the simplifying assumption is made that all schools are the same size. By starting with a pool of 28,000 students, of whom 23,000 apply ED, and assuming that each school wants to enroll a class of roughly 570 students, the model generated totals and per-school averages that align closely with the actual IC 2010 data; see Table 2 (Appendix). Note that in the model, there are fewer (total and per-school) admits, roughly 80% of the IC 2010 numbers; this in turn means that in the model, acceptance rates will be lower and yields will be higher than in the IC 2010 data. This is reasonable; recall that in the model, students only apply to schools in the larger set of 50, and will accept an offer at one of these schools, assuming they are admitted to at least one (in either the ED or regular round). In reality, some students who apply to elite liberal arts schools end up accepting offers to other types of elite institutions, such as Ivy League schools, large public universities, women's colleges, military academies or engineering schools.

The preferential rates $P_{ED} = 25\%$ and $P_{REG} = 30\%$ produced a reasonably accurate picture of the situation represented in the IC 2010 data; in what follows, these are referred to as the status quo rates. It is reasonable that the preferential rate is lower in the ED round than the regular round; the ED applicant pool tends to be weaker, so these students are already getting an admissions boost from being considered relative to other ED applicants. Table 3 (Appendix) shows the simulation numbers produced using status quo rates, averaging over 20 runs; these numbers should be compared to those in Table 1. Figures 1, 2 and 3 (Appendix) illustrate the comparison in mean SAT scores, overall acceptance rates and yields between the IC 2010 data and the simulation using status quo rates.

Another important measure of the reasonableness of the model is the difference in mean SAT scores between various groups at each school: overall admits versus overall applicants; ED admits versus ED applicants; overall admits versus ED admits; overall deposits versus ED deposits. These differences measure the extent to which admissions decisions in each round are driven by SAT scores as opposed to other factors. At our home institution, ranked 11-th in the IC 2010 data, these differences are roughly 100, 40, 70 and 30 points respectively; Table 4 (Appendix) gives the differences generated by the model for every fifth school.

In what follows, more details of the model are provided, illustrated by numbers generated by running the model 20 times and taking averages, or, where appropriate, numbers generated from a single run, using the status quo preferential rates of $P_{ED} = 25\%$ and $P_{REG} = 30\%$.

Initialization Phase

To begin the simulation process, the overall student pool is represented with a set of 28,000 simulated SAT scores, randomly drawn from a normal distribution with mean 1290 and standard deviation 120 (and rounding down to get an integer), rejecting any number above 1600 or below 400. These scores are then arranged in non-increasing order, that is, the highest score is first. Each school in the wider pool of 50 schools that forms a basis for the simulation is represented in the model by its rank, r (with $r = 0$ being the top-ranked school). Each school has a cut-off SAT score (that is, a minimum score any applicant must have in order to be considered qualified for admission) that is a function of its rank. A reasonable fit for this function, based on available data, was determined to be: cut-off score$(r) = 1100 - (r^2/8)$.

ED Round

The sub-pool of 23,000 ED applicants is created by iteratively choosing an SAT score from the overall pool and transferring it to the ED sub-pool. An assumption is that as a general rule, students applying early decision come from the lower end of the overall pool. This is simulated by generating a random number k from a chi-squared distribution with mean $\nu = 0.875N$, where N is the number of students currently in the overall pool; the k-th SAT score in the overall pool is then moved to the ED sub-pool (and N is reduced by 1). In the model's 20-run average, the ED sub-pool has a mean of 1259 and standard deviation 87. The reasonableness of these parameters is supported by Table 4 (Appendix), which shows spreads between the mean SAT scores of overall admits versus ED admits, and overall deposits versus ED deposits that are consistent with actual data.

Each student in the ED sub-pool then chooses a single school to which he or she sends an application. To model the assumption that students with higher SAT scores will generally apply to higher-ranked schools, the ED sub-pool is divided into 50 blocks by SAT score; all students in the same block use the same process for choosing a school. More precisely, each ED student in the $(1 + t)$-th block (where t begins at 0, representing the highest scoring students) randomly generates a number from a chi-squared distribution with mean $v = 1.1 + 0.2t$, then multiplies by 4 and rounds down to an integer value; this number is the rank of the single school to which the student applies. The intended effect is to have students in the t-th block apply to schools with ranks that are roughly normally distributed with mean $4.4 + 0.8t$, with a variance larger than that of the usual chi-squared distribution.

Each school now has a pool of ED applicants. All ED applicants whose SAT scores are strictly less than the school's cut-off score are rejected and thrown back into the general student pool. The number m_{ED} of ED applicants that a school admits is a fixed percentage of its qualified ED applicant pool; this percentage is modeled as a linear function of the school rank r, with the top school admitting 33% and the bottom school admitting 82%, resulting in the formula ED acceptance rate $(r) = 0.33 + 0.01r$. This formula was chosen to reflect IC 2010 data for a subset of these schools reported by *Newsweek* (Cohen, 2011); the regression line fitted to this data is ED acceptance rate $(r) = 0.3338 + 0.0117r$.

Each school determines which m_{ED} students in its qualified ED applicant pool to admit using the process described earlier, based on the common ED round preferential rate; 75% are chosen from the top SAT scores, and 25% are chosen randomly from the remaining scores. Taking a 20-run average, the number of ED applicants admitted to all 50 schools was 12,240 (with standard deviation 20), roughly 53% of the ED sub-pool. This means that the regular round pool consists of 15,760 students (56% of the original student pool).

Regular Round

The regular round pool is divided into 50 blocks by SAT score, with all students in the same block using the same process for choosing a set of schools to which to apply. More precisely, each student in the $(1 + t)$-th block (where t begins at 0) randomly generates 20 numbers from a chi-squared distribution with $v = 0.18 + 0.125t$, then multiplies each by 7.5 and rounds down to an integer value; if the resulting number is greater than 49, it is rejected and a new number is generated. Each number is the rank of a school to which the student applies. The intended effect is to have students in the t-th block apply to schools that are roughly normally distributed with mean $1.35 + 0.93758t$, with a variance larger than that of the usual chi-squared distribution. Note that because of rounding, these 20 schools will rarely all be different; in fact, the average number of schools to which a regular round student applies is 14. Students with high SAT and students with low SAT scores may in fact apply to even fewer schools, because it is more likely that two or more values of their school choice random variable will round to the same integer. This reasonably models the assumptions that (a) better students are more confident of getting into one of the schools they apply to, and thus send in fewer applications, and (b) weaker students may also be submitting applications to schools outside the top 50 institutions. Table 5 (Appendix) shows the set of application schools for 10 sample students obtained in one run of the model; more precisely, the table shows the set of schools for one student from the t-th block, for 10 select values of t.

Each school now has a pool of regular round applicants. All applicants whose SAT scores do not meet a school's minimum are rejected as unqualified. It is assumed that each school wants 570 deposits; all ED admits are counted as deposits. To determine the number m_{REG} of qualified regular applicants it should admit, the school divides the remaining desired number of deposits by the assumed regular round yield, which is a function of its rank r, namely $Y(r) = 0.30 - 0.004r$. Note that this assumed regular round yield may differ from the simulated regular round yield (the simulated number of regular round deposits divided by the simulated number of regular round admits). However, when combined with the ED round yield, this generates reasonable values of overall yield for the set of 35 schools; see Table 6 and Figure 4 (Appendix). Recall that because the students in the model can only deposit at one of the 50 schools in the model, the overall yield in the model is generally greater than it is in the IC 2010 data. Also, because it is averaging over 20 runs, the model's overall yield looks smoother than the IC 2010 data.

Each school determines which m_{REG} students from its qualified applicant pool to admit using the process described earlier, based on the common regular round preferential rate; 75% are chosen from the top SAT scores, and 25% are chosen randomly from the remaining scores. If the number of qualified applicants is less than the desired number of admits, in either the non-preferential or preferential phase, the school admits the entire pool. (This does happen in the model, but only for schools of rank 45 or greater. In reality, these schools would probably be receiving applications from students outside the pool in the model, *i.e.* from students who do not restrict their applications to the top 50 liberal arts colleges.)

Each (regular round) student now has a set of admission offers. With the status quo preferential rate of $P_{REG} = 30\%$, each student receives, on average, 5 admission offers. Table 7 (Appendix) gives a set of admission offers corresponding to the students whose application schools are given in Table 5. Some students will receive no offers; in the 20-run average of the model, there are 56 such students (0.2% of the original pool).

All students having a nonempty set of admission offers must choose which offer to accept. In general, students favor higher-ranked schools over lower-ranked ones, but other factors may play into their decision, such as geography, relative strength of their preferred academic departments, or whether they liked their tour guide, and so the model uses a random variable to simulate their selection process. The distribution of this random variable depends on a student's academic profile. The top student has likely applied to and been accepted at (in the non-preferential phase) a set of schools clustered near the top of the rankings, with little academic difference between them. On the other hand, the bottom student is likely to have applied at a much wider range of schools; such a student will probably weigh more heavily an offer from a highly ranked school that s/he managed to get into in the preferential phase. In the model, if a student is in the t-th block (of 50 blocks, with t starting at 0) and is admitted to n schools, then the distribution of the school selection random variable is the n-vector $\frac{t}{n}[n-1, n-2, \ldots, 1, 0] + [1, 1, \ldots, 1, 1]$ multiplied by an appropriate scalar so that the vector components sum to 1. Thus, a student in the top block who gets accepted to 5 schools uses the probability distribution vector [0.2, 0.2, 0.2, 0.2, 0.2] to select a school, a student in the 24-th block uses [0.392, 0.296, 0.200, 0.104, 0.008] and a student in the last block uses [0.396, 0.298, 0.200, 0.102, 0.004].

EFFECT OF VARYING PREFERENTIAL RATES

Although the model containing some simplifying assumptions, it has been shown to replicate existing data fairly well, and so can be used to predict the effect of varying preferential admission rates. Recall that a central assumption is that all 50 schools in the model act in concert, in that they all use preferential rates P_{ED} in the ED round and P_{REG} in the regular round, where the status quo values are taken to be $P_{ED} = 25\%$ and $P_{REG} = 30\%$. A first impulse is to look at the extremes of the possible range; $P_{ED} = P_{REG} = 0\%$ (no preferential admissions) and $P_{ED} = P_{REG} = 100\%$ (*only* preferential admissions). The results produced by the model (20-run averages) are given in Table 8 (Appendix).

Figure 5 shows higher mean SAT scores when $P_{ED} = P_{REG} = 0\%$ and lower ones when $P_{ED} = P_{REG} = 100\%$, compared to the mean SAT scores under status quo rates; this is exactly what is expected. However, it is important to also take note of the fluctuation in the number of deposits, as shown in Figure 6 (Appendix). Overall, as preferential rates increase, the total number of deposits over all 35 schools increases from 17,999 to 19,884 to 21,317; the average size of the incoming class increases from 514 to 568 to 609. This is also to be expected; as preferential rates go up, more students from further down in the SAT pool are admitted to highly ranked institutions, and these students are more likely to deposit at the highest ranked school to which they are admitted. In particular, note that when $P_{ED} = P_{REG} = 0\%$, schools of rank 2 through 20 matriculate fewer than 500 students, probably creating serious budgetary shortfalls. The problem is that there is too much overlap among the sets of admitted students at the top institutions; these schools are all competing for the same set of high-scoring students. (There is less overlap when each school admits a certain proportion of its qualified applicant pool randomly.) Conversely, when $P_{ED} = P_{REG} = 100\%$, the top 12 schools all matriculate more than 600 students, with the first 4 matriculating more than 700; under status quo rates, these schools matriculate classes of size less than 560. Larger incoming classes mean more tuition dollars, but they also mean more crowding in dorms, higher student-to-faculty ratios and the possibility of students getting closed out of classes.

Meaningful comparisons cannot be drawn regarding mean SAT scores when there is so much variation in the number of total deposits. Class sizes can be managed by adjusting the number of admits, which in turn can be adjusted by changing the assumed regular round yield function, $Y(r)$. For a given pair of preferential rates, such a function is deemed to be reasonable if the number of deposits over the 50 schools had an average between 565 and 575, with standard deviation less than 50, and the assumed regular round yield gave a good estimate of the simulated regular round yield. In the case of no preferential admissions ($P_{ED} = P_{REG} = 0\%$), the top-ranked schools need to admit more students; this will lower the mean SAT score of their set of admitted students, which will in turn lower the mean SAT score of the incoming class. On the other hand, in the case of all preferential admissions ($P_{ED} = P_{REG} = 100\%$), the top-ranked schools must admit fewer students, but since they are admitting randomly from their (qualified) applicant pool, this should not substantially affect the SAT profile.

When $P_{ED} = P_{REG} = 0\%$, reasonable class sizes are obtained by replacing the status quo assumed regular round yield function $Y(r) = 0.30 - 0.004r$ with the piece-wise linear function

$$Y_{0,0}(r)=\begin{cases} 0.26-0.016r & 0\le r<8,\\ 0.15-0.003(r-7) & 8\le r<18,\\ 0.12, & 18\le r<50.\end{cases}$$

Figure 7 shows how this assumed regular round yield function compares to the simulated regular round yield (20-run average). The total number of deposits at the top 35 schools is 19, 899, with an average of 568.5 and standard deviation of 24.5; by the stated criteria, these are comparable to the status quo numbers. With the new generally lower assumed regular round yield, the number of admission offers per student rises to 6 (from 5 in the status quo model). Table 9 (Appendix) shows the academic profile numbers generated by the model, using $Y_{0,0}$.

In the case where all admissions decisions are preferential ($P_{ED}=P_{REG}=100\%$), reasonable class sizes are obtained by changing the assumed regular round yield function to

$$Y_{1,1}=\begin{cases} 0.60-0.018r & 0\le r<15,\\ 0.33-0.007(r-15) & 15\le r<50.\end{cases}$$

Figure 8 (Appendix) shows that this closely resembles the actual regular round yield produced by the model (20-run average). Using $Y_{1,1}$, the model gives 19, 950 total deposits, giving an average of 570.1 per school, with standard deviation of 39.4; these are comparable to status quo numbers. With higher assumed yields, the average number of admission offers a regular round student gets has dropped from 5 to 4. The academic profile numbers produced by the model are shown in Table 10 (Appendix).

When $P_{ED}=P_{REG}=100\%$, each school is accepting a randomly chosen subset of its qualified applicant pool. (In fact, the effect of each school's cut-off SAT score is negligible; if the model is run with no cut-off scores, the regression line changes from mean SAT score, where r is the school rank, to mean SAT score$(r)=1393.55-5.25r$.) Thus, in this case the distribution of mean SAT scores among the incoming classes is just a reflection of the distribution of mean SAT scores among the applicant pools. What Table 10 shows is that a great deal of the variation in the academic profile of the top 35 schools is due to the self-selection of student applicants, not to the admissions decisions each of these schools makes.

Running the model using extreme rates $P_{ED}=P_{REG}=0\%$ and $P_{ED}=P_{REG}=100\%$ does give a sense of the range of possibilities. However, more likely scenarios have preferential rates are half the status quo rates ($P_{ED}=12.5\%$, $P_{REG}=15\%$) and double the status quo rate ($P_{ED}=50\%$, $P_{REG}=60\%$). The corresponding adjusted assumed regular round yield functions used were

$$Y_{.125,.15}(r)=\begin{cases} 0.28-0.012r & 0\le r<7,\\ 0.20-0.004(r-7) & 7\le r<13,\\ 0.17 & 13\le r<50,\end{cases}$$

and $Y_{.50,.60}(r)=0.44-0.0058r$.

As usual, the model ran 20 simulations and then averages were computed. Figure 9 (Appendix) illustrates that the numbers of total deposits under the different preferential rates with corresponding adjusted regular round yield functions are comparable. Figures 10 and 11 (Appendix) show the effect on overall acceptance rates and overall yields; the IC 2010 data are included to demonstrate that the curves are all the right basic shape. However, note that reducing preferential rates increases acceptance rates and decreases yield across all institutions in our group of selective liberal arts colleges. Given that acceptance rate and yield are among the measures *US*

News and World Report uses to compute its rankings, such changes could negatively impact applicants' perception of these schools relative to other types of institutions, such as Ivy League schools or large public universities.

Figure 12 (Appendix) shows the mean SAT scores under these different preferential rates, with the appropriately adjusted assumed regular round yield functions; compare to Figure 5 (Appendix). What is astonishing is how little difference there is between the graphs corresponding to preferential rates strictly less than 100%; in schools ranked 22 through 32, there is no more than a 16-point difference. Doubling the rates of preferential admissions from status quo values makes essentially no difference in schools ranked 11 through 35. The model predicts that the adjustments in assumed yields necessary to produce reasonably sized incoming classes essentially cancel out the desired effect of raising the academic profiles of the schools.

Note also in Figure 12 (Appendix) that the graphs cross around the 27-th ranked school; the incoming classes at schools ranked lower than this actually have higher mean SAT scores when more students are admitted preferentially. In effect, preferential admission decisions 'spread the wealth' among these institutions; high-scoring students who are denied admission to a top-ranked school because spots are made available to minorities, athletes, musicians or legacies ultimately raise the academic profile of the lower-ranked institutions to which they eventually accept admission.

SUMMARY

This model shows how preferential admission practices can affect the academic profile of incoming classes at a set of selective liberal arts colleges. Although simplifying assumptions were made in the construction of the model, the reasonableness of these assumptions is supported by the model's creation of simulated incoming classes that are similar to those of the actual 2010 incoming classes. This mirroring of the actual profiles gives us confidence that these findings are meaningful and can inform admission policies and practices.

Most importantly, the model suggests that varying preferential admissions policies, even very drastically, would have little impact on academic quality of the student body for a majority of the schools in the group, assuming all schools use the same policy. This occurs primarily because changes in preferential rates must be balanced by adjustments in the number of admitted students in order to produce the desired number of enrollments. In particular, reducing preferential admissions in an attempt to raise academic standards leads to reduced yield because too many schools are competing for the same high-scoring students, and this must be balanced by increasing the acceptance rate. If schools reach further down in their applicant pool, then the mean SAT score of admitted students will drop. Additionally, the resulting decreased yields and increased acceptance rates could have the effect of making small liberal arts colleges less competitive with other types of institutions. On the other hand, the model predicts that if preferential rates are increased to twice the current levels, acceptance rates can be decreased, yields will increase, and there will be virtually no negative effect on mean SAT score for schools ranked below the top 10.

Indeed, the model suggests that the comparative academic profile of the targeted group of selective liberal arts colleges is largely due to the self-selection of applicants; high-scoring students tend to apply to and accept offers at highly ranked schools. Thus the comparative profile is unlikely to change significantly as long as students' perceptions of the relative merits of these schools remains the same, and these similar institutions continue to use similar preferential admissions policies.

A possible avenue for further research is to investigate the effect of a single school (or subset of schools) modifying its admissions policies. Another underlying assumption in the model is that student applicants are unaware of changes in preferential admissions policies, and do not adjust their application strategies accordingly; while this may be realistic in the short term, it may not be over the long run. Finally, a more comprehensive model could investigate the effect of varying preferential admissions policies across different types of institutions, including public universities, military academies and women's colleges.

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APPENDIX

Table 1

IC 2010 at top 35 liberal arts institutions

Rank	Institution Name	Appl'ns	Admits	Deposits	Mean SAT	Accept. Rate	Yield	*USN&WR* Rank
1	Amherst College	8099	1240	490	1440	0.15	0.40	2
2	Swarthmore College	6041	974	388	1435	0.16	0.40	3
3	Williams College	6017	1229	546	1420	0.20	0.44	1
4	Bowdoin College	6018	1183	510	1405	0.20	0.43	6
5	Carleton College	4856	1496	512	1400	0.31	0.34	8
6	Wesleyan University	10068	2218	745	1395	0.22	0.34	12
7	Haverford College	3312	860	325	1395	0.26	0.38	9
8	Middlebury College	7984	1375	577	1385	0.17	0.42	4
9	Washington & Lee	6627	1259	472	1385	0.19	0.37	14
10	Vassar College	7822	1847	666	1385	0.24	0.36	12
11	Hamilton College	4857	1430	467	1385	0.29	0.33	18
12	Bard College	5570	1961	497	1375	0.35	0.25	38
13	Oberlin College	7222	2207	784	1365	0.31	0.36	23
14	Colgate University	7872	2597	852	1365	0.33	0.33	21
15	Macalester College	4317	1837	514	1355	0.43	0.28	26
16	Barnard College	4618	1285	573	1345	0.28	0.45	26
17	Davidson College	4088	1205	501	1345	0.29	0.42	9
18	Grinnell College	2845	1228	415	1345	0.43	0.34	18
19	Kenyon College	4064	1598	483	1340	0.39	0.30	32
20	Colby College	4213	1440	486	1335	0.34	0.34	23
21	Bates College	4517	1437	495	1325	0.32	0.34	21
22	Connecticut College	4733	1732	503	1320	0.37	0.29	41
23	Bucknell University	7178	2253	929	1300	0.31	0.41	30
24	Gettysburg College	5392	2173	721	1300	0.40	0.33	47
25	Franklin & Marshall	4934	2204	634	1300	0.45	0.29	41
26	Trinity College	4688	2024	591	1285	0.43	0.29	36
27	University of	8661	2857	817	1280	0.33	0.29	32
28	College of the Holy	6911	2451	727	1280	0.35	0.30	32
29	Union College	4946	2094	554	1280	0.42	0.26	41
30	Dickinson College	5033	2405	657	1280	0.48	0.27	47
31	Lafayette College	5822	2430	648	1275	0.42	0.27	38
32	Furman University	4538	3080	656	1275	0.68	0.21	41
33	Rhodes College	5039	2113	432	1265	0.42	0.20	47
34	Centre College	2260	1683	356	1265	0.74	0.21	47
35	Skidmore College	6011	2813	768	1240	0.47	0.27	41

Table 2
IC 2010 data vs. Simulation (20-run average): Sizes

		Applications	Admits	Deposits
IC 2010	Total	197173	64218	20291
	Mean per School	5633	1834	580
Model	Total	202307	53078	19884
(20-run average)	Mean per School	5780	1516	568

Table 3
Simulation Results (20-run average, status quo rates)

Rank	Applications	Admits	Deposits	Mean SAT	Acceptance Rate	Yield
1	6860	1273	556	1454	0.19	0.44
2	6795	1383	539	1441	0.20	0.39
3	6738	1401	530	1427	0.21	0.38
4	6681	1412	513	1415	0.21	0.36
5	6674	1408	517	1404	0.21	0.37
6	6648	1401	518	1395	0.21	0.37
7	6638	1395	509	1386	0.21	0.36
8	6597	1405	517	1379	0.21	0.37
9	6611	1405	518	1371	0.21	0.37
10	6578	1392	519	1365	0.21	0.37
11	6541	1384	518	1360	0.21	0.37
12	6425	1407	527	1354	0.22	0.37
13	6387	1392	530	1347	0.22	0.38
14	6371	1391	532	1342	0.22	0.38
15	6236	1407	539	1337	0.23	0.38
16	6180	1394	543	1331	0.23	0.39
17	6084	1398	543	1326	0.23	0.39
18	6033	1395	554	1322	0.23	0.40
19	5932	1417	563	1319	0.24	0.40
20	5837	1404	556	1312	0.24	0.40
21	5720	1448	570	1307	0.25	0.39
22	5603	1475	573	1302	0.26	0.39
23	5496	1489	582	1299	0.27	0.39
24	5382	1504	583	1293	0.28	0.39
25	5273	1524	593	1288	0.29	0.39
26	5116	1600	606	1284	0.31	0.38
27	5008	1607	604	1277	0.32	0.38
28	4891	1661	616	1273	0.34	0.37
29	4784	1676	623	1269	0.35	0.37
30	4648	1724	632	1262	0.37	0.37
31	4545	1769	633	1258	0.39	0.36
32	4438	1824	633	1253	0.41	0.35
33	4302	1902	656	1247	0.44	0.34
34	4188	1978	669	1242	0.47	0.34
35	4067	2033	670	1236	0.50	0.33

Table 4
Simulated Differences in SAT scores (20-run average, status quo rates)

Rank	Overall (Admits-Applicants)	ED (Admits-Applicants)	(Overall-ED) Admits	(Overall-ED) Deposits
1	61	15	88	59
6	87	32	67	30
11	101	40	64	22
16	104	44	66	21
21	103	42	68	22
26	93	37	63	21
31	79	33	56	15

Table 5
Sample Sets of Application Schools

t	Set of Application Schools
4	{0, 1, 2, 3, 4, 6, 7, 8, 16, 30}
9	{0, 1, 2, 3, 4, 7, 8, 11, 14, 16, 23, 24, 27}
14	{2, 3, 4, 5, 8, 9, 11, 17, 18, 20, 25, 30, 31, 32, 44}
19	{1, 4, 5, 6, 8, 10, 13, 16, 17, 20, 21, 24, 32, 36, 47}
24	{0, 2, 3, 5, 6, 7, 8, 10, 11, 13, 16, 19, 21, 23, 29, 30, 38}
29	{1, 2, 12, 15, 16, 18, 19, 21,22, 24, 25, 26, 31, 32, 35, 36, 40, 41}
34	{4, 8, 9, 11, 16, 17, 18, 20, 22, 23, 27, 28, 29, 30, 37, 38, 42, 46}
39	{10, 13, 15, 20, 21, 23, 24, 26, 27, 33, 42, 43, 46, 48, 49}
44	{5, 6, 8, 9, 12, 14, 18, 22, 23, 24, 28, 29, 31, 34, 36}
49	{10, 12, 13, 15, 16, 17, 20, 25, 27, 32, 40, 41, 42, 43, 46, 48 }

Table 6

Simulated Yields (20-run average, status quo rates)

Rank	Assumed Regular Round Yield	Simulated Regular Round Yield	Simulated Overall Yield	IC 2010 Overall Yield
1	0.300	0.31	0.44	0.40
2	0.296	0.29	0.39	0.40
3	0.292	0.28	0.38	0.44
4	0.288	0.26	0.36	0.43
5	0.284	0.26	0.37	0.34
6	0.280	0.25	0.37	0.34
7	0.276	0.24	0.36	0.38
8	0.272	0.24	0.37	0.42
9	0.268	0.24	0.37	0.37
10	0.264	0.24	0.37	0.36
11	0.260	0.23	0.37	0.33
12	0.256	0.24	0.37	0.25
13	0.252	0.23	0.38	0.36
14	0.248	0.23	0.38	0.33
15	0.244	0.24	0.38	0.28
16	0.240	0.23	0.39	0.45
17	0.236	0.23	0.39	0.42
18	0.232	0.24	0.40	0.34
19	0.228	0.24	0.40	0.30
20	0.224	0.23	0.40	0.34
21	0.220	0.24	0.39	0.34
22	0.216	0.24	0.39	0.29
23	0.212	0.24	0.39	0.41
24	0.208	0.24	0.39	0.33
25	0.204	0.24	0.39	0.29
26	0.200	0.24	0.38	0.29
27	0.196	0.24	0.38	0.29
28	0.192	0.24	0.37	0.30
29	0.188	0.24	0.37	0.26
30	0.184	0.24	0.37	0.27
31	0.180	0.24	0.36	0.27
32	0.176	0.23	0.35	0.21
33	0.172	0.24	0.34	0.20
34	0.168	0.24	0.34	0.21
35	0.164	0.23	0.33	0.27

Table 7
Sample Admission Offers

t	Set of admission offers
4	{2, 3, 4, 6, 7, 8, 16, 30}
9	{1, 11, 14, 16, 23, 24, 27}
14	{9, 20, 25, 30, 31, 32, 44}
19	{6, 17, 32, 36, 47}
24	{38}
29	{35, 36, 40, 41}
34	{17, 20, 28, 37, 38, 42, 46}
39	{42, 43, 46, 48, 49}
44	{29}
49	{41, 42, 43, 46, 48}

Table 8
Extreme Preferential Rates vs. Status Quo Rates

	$P_{ED} = P_{REG} = 0\%$		$P_{ED} = 25\%,\ P_{REG} = 50\%$		$P_{ED} = P_{REG} = 100\%$	
Rank	Deposits	Mean SAT	Deposits	Mean SAT	Deposits	Mean SAT
1	528	1474	556	1454	803	1429
2	484	1465	539	1441	788	1416
3	459	1454	530	1427	744	1403
4	446	1444	513	1415	706	1390
5	438	1435	517	1404	688	1381
6	441	1428	518	1395	674	1370
7	441	1420	509	1386	650	1361
8	444	1414	517	1379	636	1351
9	443	1406	518	1371	630	1343
10	444	1401	519	1365	616	1336
11	443	1393	518	1360	612	1329
12	455	1389	527	1354	606	1322
13	455	1382	530	1347	597	1314
14	457	1377	532	1342	587	1308
15	470	1372	539	1337	589	1303
16	474	1364	543	1331	587	1298
17	473	1359	543	1326	582	1290
18	487	1352	554	1322	579	1287
19	485	1346	563	1319	577	1282
20	498	1340	556	1312	573	1274
21	506	1334	570	1307	576	1271
22	514	1328	573	1302	581	1267
23	525	1324	582	1299	570	1263
24	532	1317	583	1293	569	1258
25	547	1312	593	1288	569	1254
26	545	1306	606	1284	571	1249
27	569	1301	604	1277	568	1247
28	579	1296	616	1273	567	1244
29	591	1290	623	1269	570	1239
30	597	1283	632	1262	563	1237
31	614	1276	633	1258	555	1232
32	639	1270	633	1253	568	1229
33	650	1262	656	1247	560	1227
34	649	1257	669	1242	556	1224
35	677	1247	670	1236	550	1221

Table 9

Simulation Results (20-run average); $P_{ED} = P_{REG} = 0\%$

Rank	Applications	Admits	Deposits	Mean SAT	Acceptance Rate	Yield
1	6855	1436	570	1475	0.21	0.40
2	6801	1630	537	1466	0.24	0.33
3	6738	1733	515	1453	0.26	0.30
4	6671	1839	522	1444	0.28	0.28
5	6633	1958	532	1435	0.30	0.27
6	6642	2076	540	1426	0.31	0.26
7	6635	2207	557	1419	0.33	0.25
8	6621	2374	582	1410	0.36	0.25
9	6570	2380	575	1401	0.36	0.24
10	6552	2354	559	1392	0.36	0.24
11	6495	2353	560	1386	0.36	0.24
12	6449	2365	557	1377	0.37	0.24
13	6407	2370	556	1369	0.37	0.23
14	6315	2385	558	1362	0.38	0.23
15	6288	2354	555	1355	0.37	0.24
16	6174	2433	560	1346	0.39	0.23
17	6092	2459	567	1338	0.40	0.23
18	5970	2492	578	1331	0.42	0.23
19	5914	2454	570	1326	0.41	0.23
20	5798	2471	578	1319	0.43	0.23
21	5692	2411	562	1314	0.42	0.23
22	5593	2401	559	1307	0.43	0.23
23	5515	2387	560	1301	0.43	0.23
24	5380	2363	563	1296	0.44	0.24
25	5251	2364	558	1290	0.45	0.24
26	5154	2436	573	1282	0.47	0.24
27	5028	2408	570	1276	0.48	0.24
28	4910	2416	570	1271	0.49	0.24
29	4772	2536	592	1261	0.53	0.23
30	4658	2514	594	1256	0.54	0.24
31	4528	2527	598	1249	0.56	0.24
32	4412	2572	604	1241	0.58	0.23
33	4309	2625	621	1235	0.61	0.24
34	4151	2647	624	1226	0.64	0.24
35	4047	2675	623	1220	0.66	0.23

Table 10

Simulation Results (20-run average): $P_{ED} = P_{REG} = 100\%$

Rank	Applications	Admits	Deposits	Mean SAT	Accept. Rate	Yield
1	6832	872	644	1427	0.13	0.74
2	6727	925	605	1414	0.14	0.65
3	6693	923	595	1396	0.14	0.64
4	6696	927	546	1388	0.14	0.59
5	6617	970	554	1376	0.15	0.57
6	6583	932	540	1371	0.14	0.58
7	6609	966	564	1359	0.15	0.58
8	6602	970	538	1357	0.15	0.55
9	6421	986	542	1345	0.15	0.55
10	6547	980	509	1334	0.15	0.52
11	6484	1003	522	1331	0.15	0.52
12	6550	975	530	1325	0.15	0.54
13	6407	1021	560	1319	0.16	0.55
14	6337	1038	546	1315	0.16	0.53
15	6167	1070	561	1309	0.17	0.52
16	6168	1088	540	1296	0.18	0.50
17	6155	1068	527	1296	0.17	0.49
18	6097	1081	546	1284	0.18	0.51
19	5840	1113	531	1280	0.19	0.48
20	5901	1090	545	1279	0.18	0.50
21	5739	1154	543	1274	0.20	0.47
22	5660	1086	546	1265	0.19	0.50
23	5539	1228	558	1269	0.22	0.45
24	5391	1231	588	1267	0.23	0.48
25	5323	1247	559	1257	0.23	0.45
26	4994	1333	585	1254	0.27	0.44
27	4962	1386	580	1257	0.28	0.42
28	4882	1433	595	1244	0.29	0.42
29	4757	1461	605	1249	0.31	0.41
30	4729	1516	583	1242	0.32	0.38
31	4530	1586	613	1233	0.35	0.39
32	4522	1632	624	1243	0.36	0.38
33	4292	1889	629	1238	0.44	0.33
34	4127	1985	614	1231	0.48	0.31
35	4054	2098	687	1235	0.52	0.33

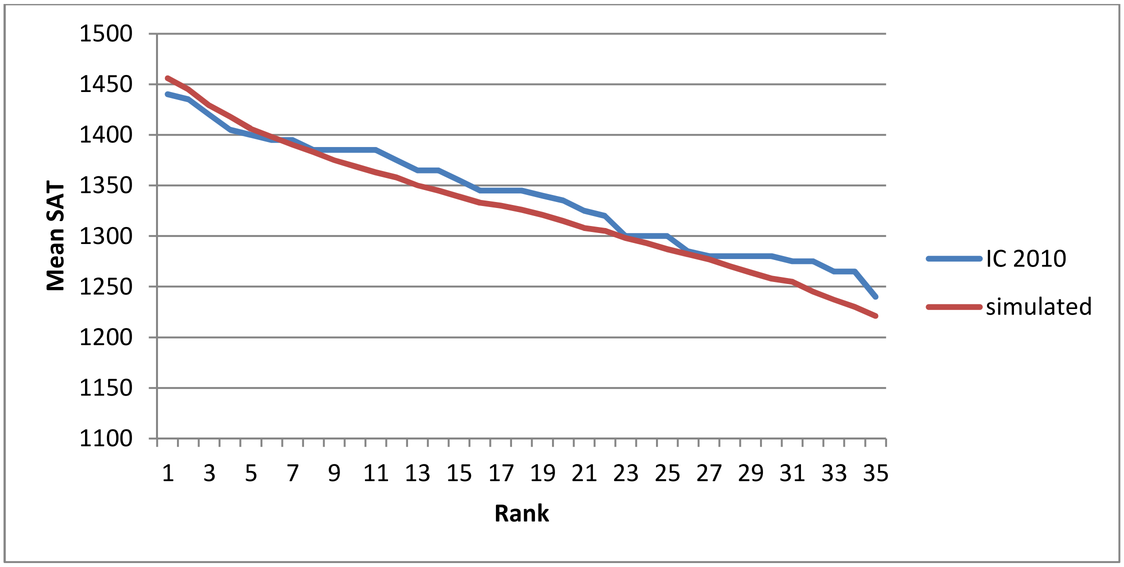

Figure 1. IC 2010 vs. Simulation (Status Quo Rates, 20-run average): Mean SAT

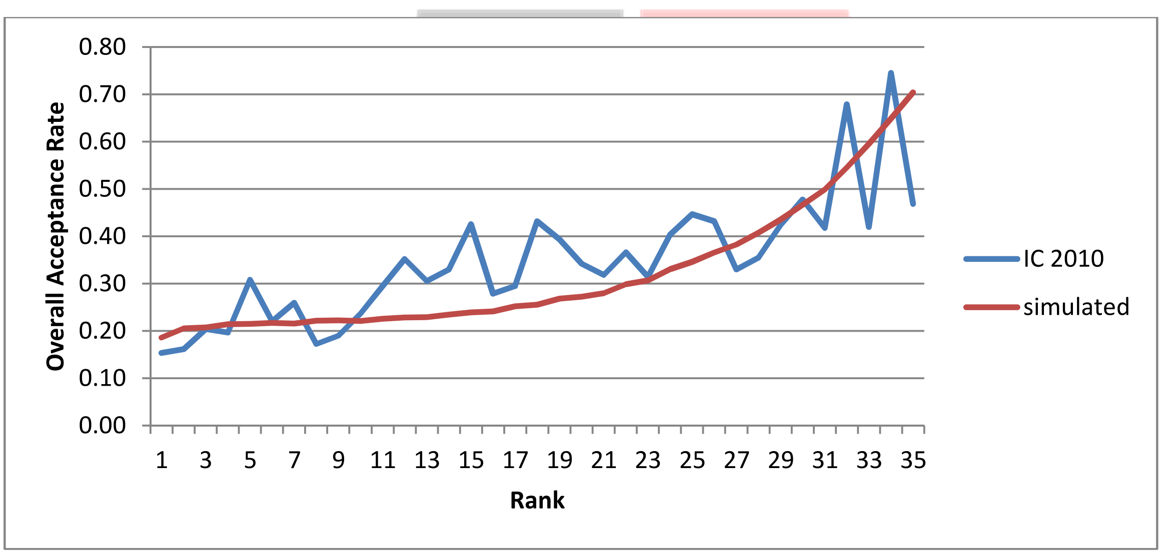

Figure 2. IC 2010 vs. Simulation (Status Quo Rates, 20-run average): Overall Acceptance Rate

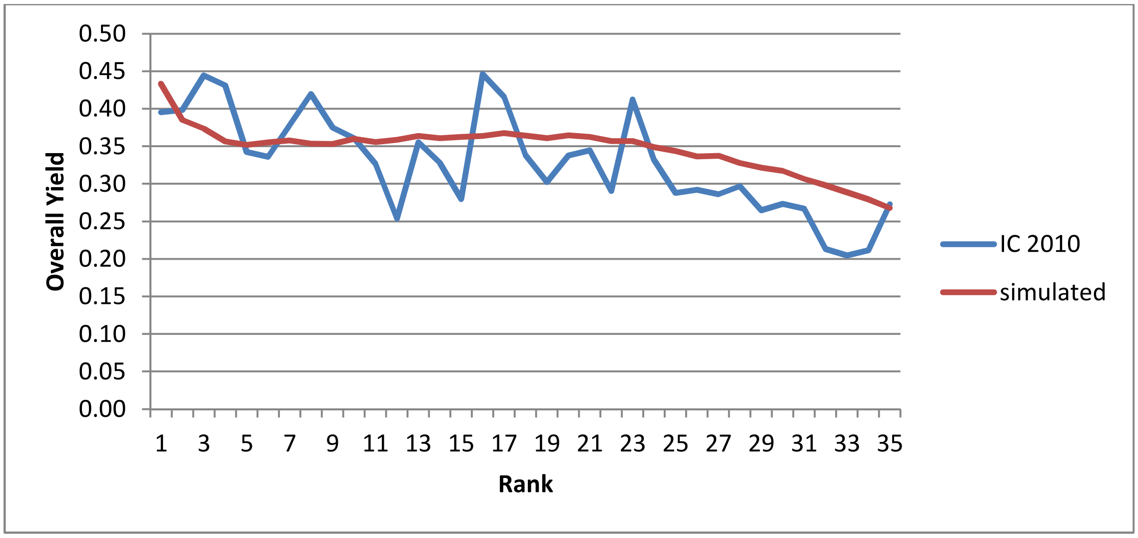

Figure 3. IC 2010 vs. Simulation (Status Quo Rates, 20-run average): Overall Yield

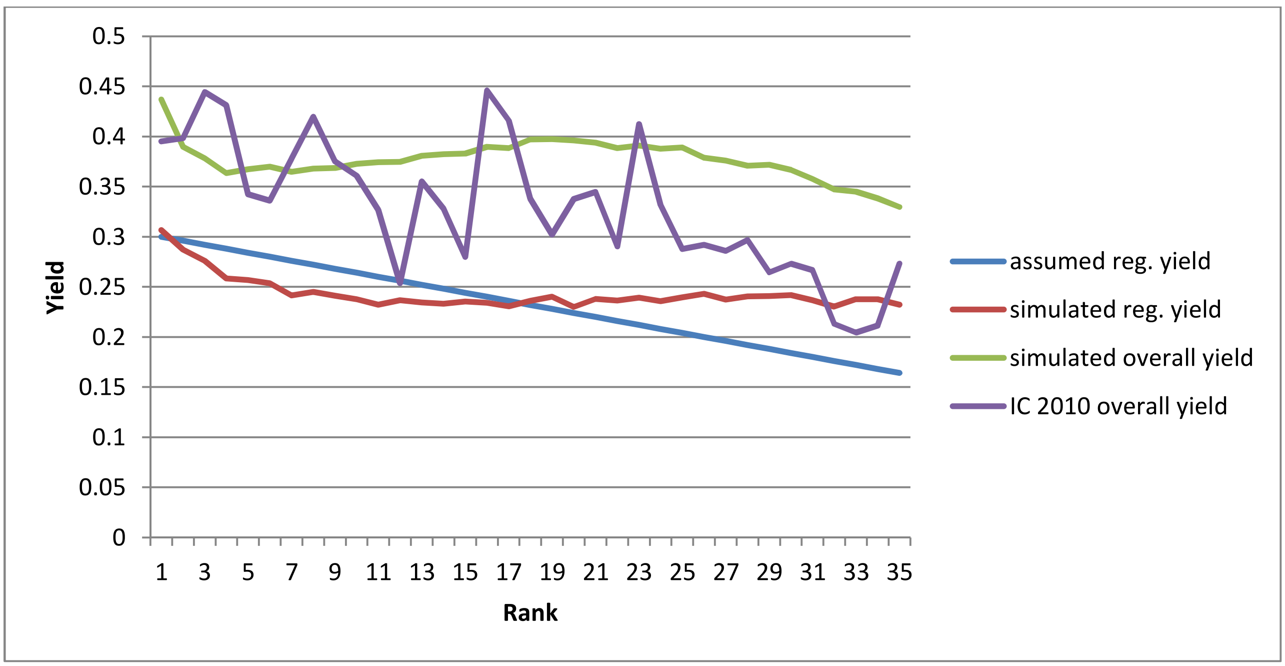

Figure 4. Yields with Status Quo Rates $P_{ED} = 25\%, P_{REG} = 30\%$

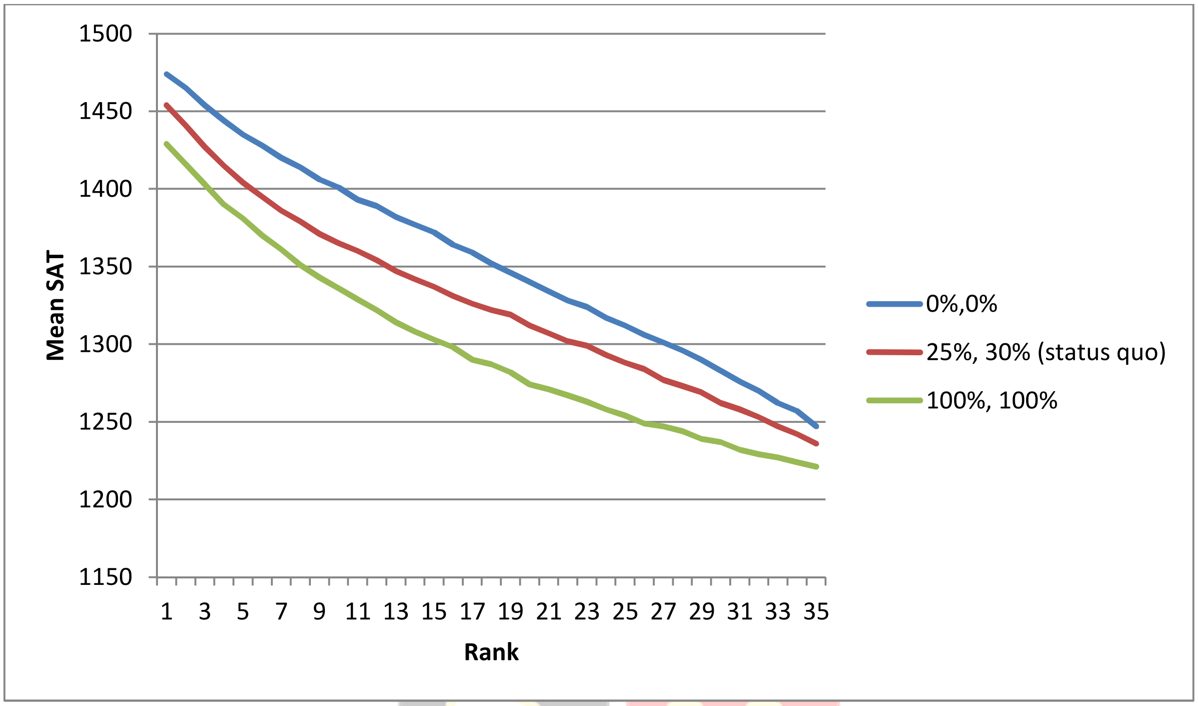

Figure 5. Extreme Preferential Rates vs. Status Quo Rates: Mean SAT Scores

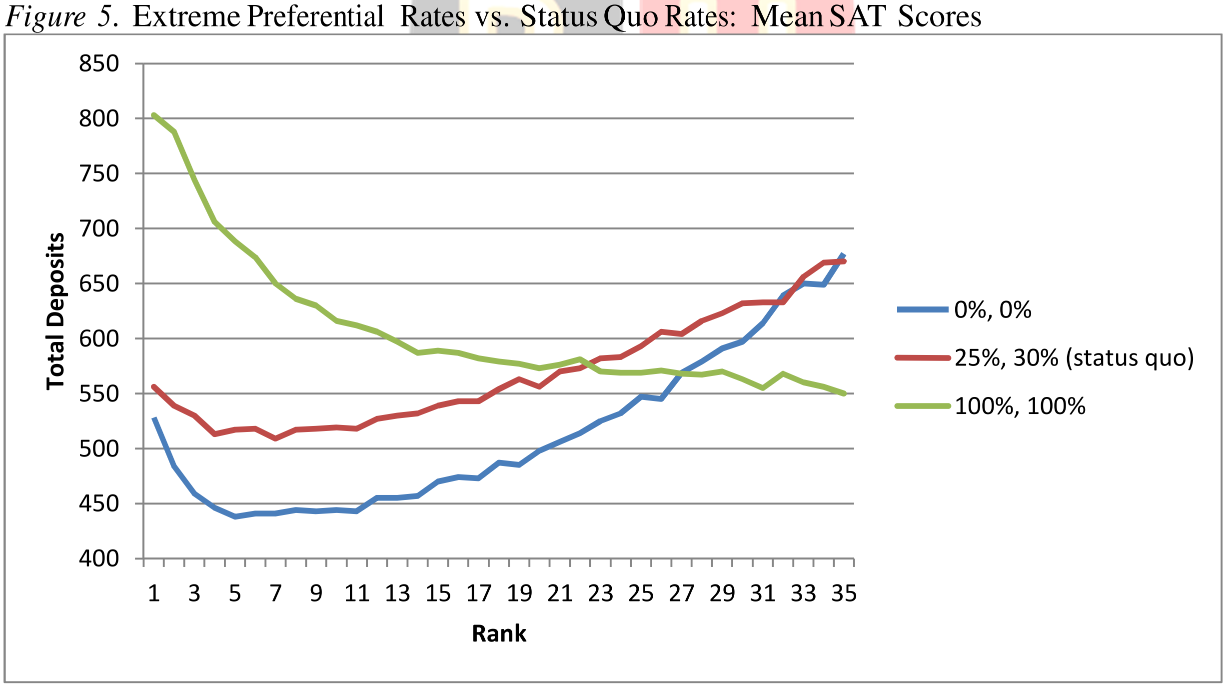

Figure 6. Extreme Preferential Rates vs. Status Quo Rates: Total Deposits

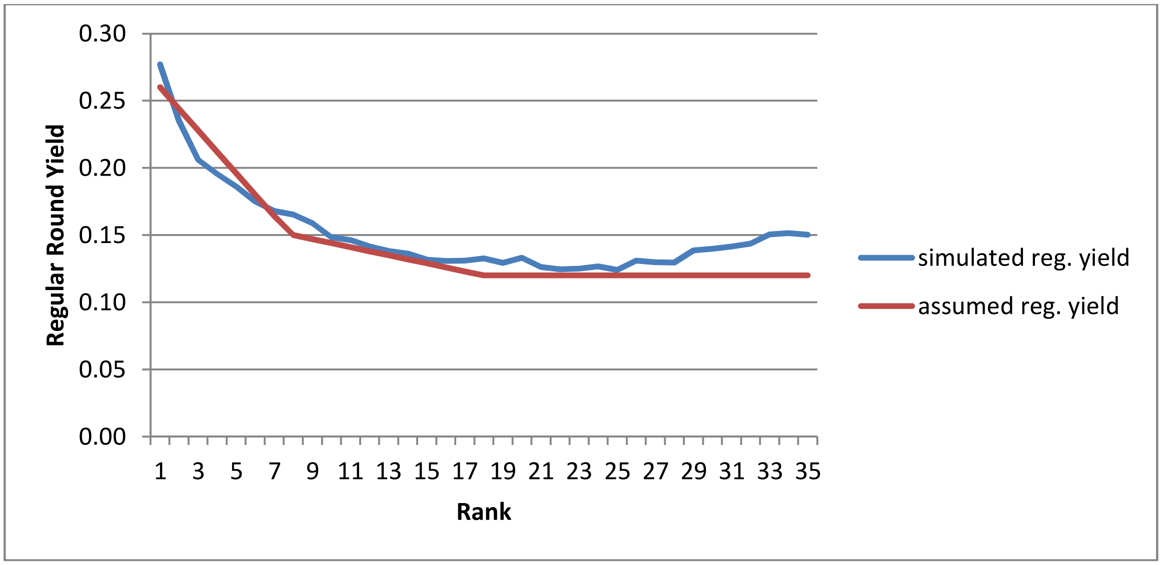

Figure 7. Regular Round Yields with $Y_{0,0}$, $P_{ED} = P_{REG} = 0\%$

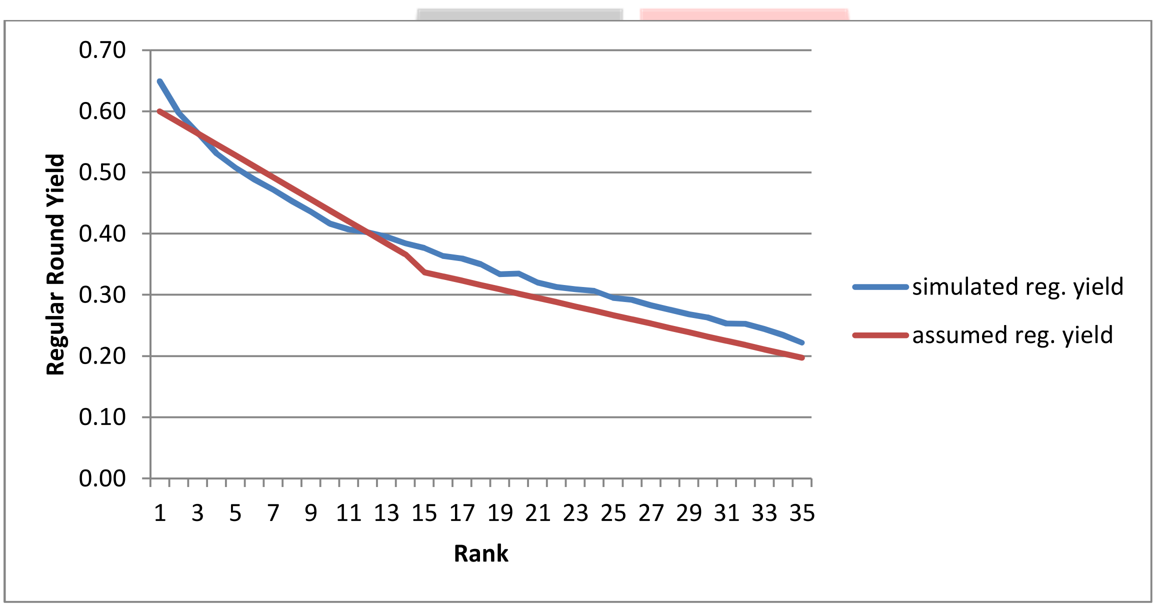

Figure 8. Regular Round Yields with $Y_{1,1}$, $P_{ED} = P_{REG} = 100\%$

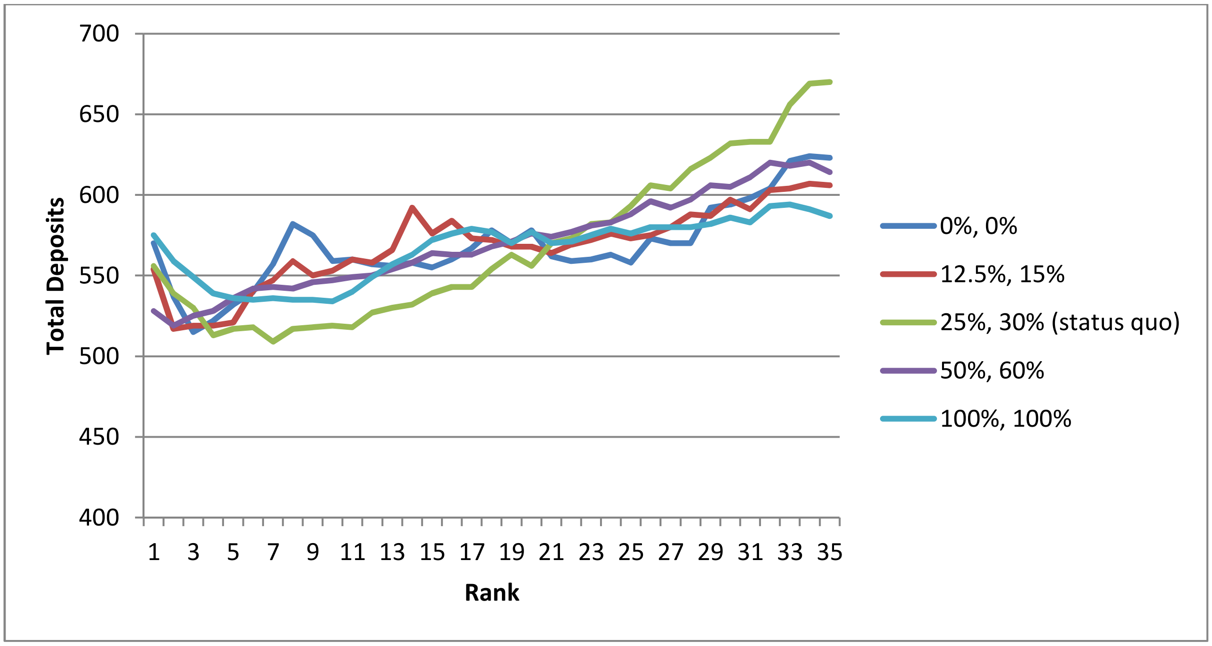

Figure 9. Comparative Total Deposits

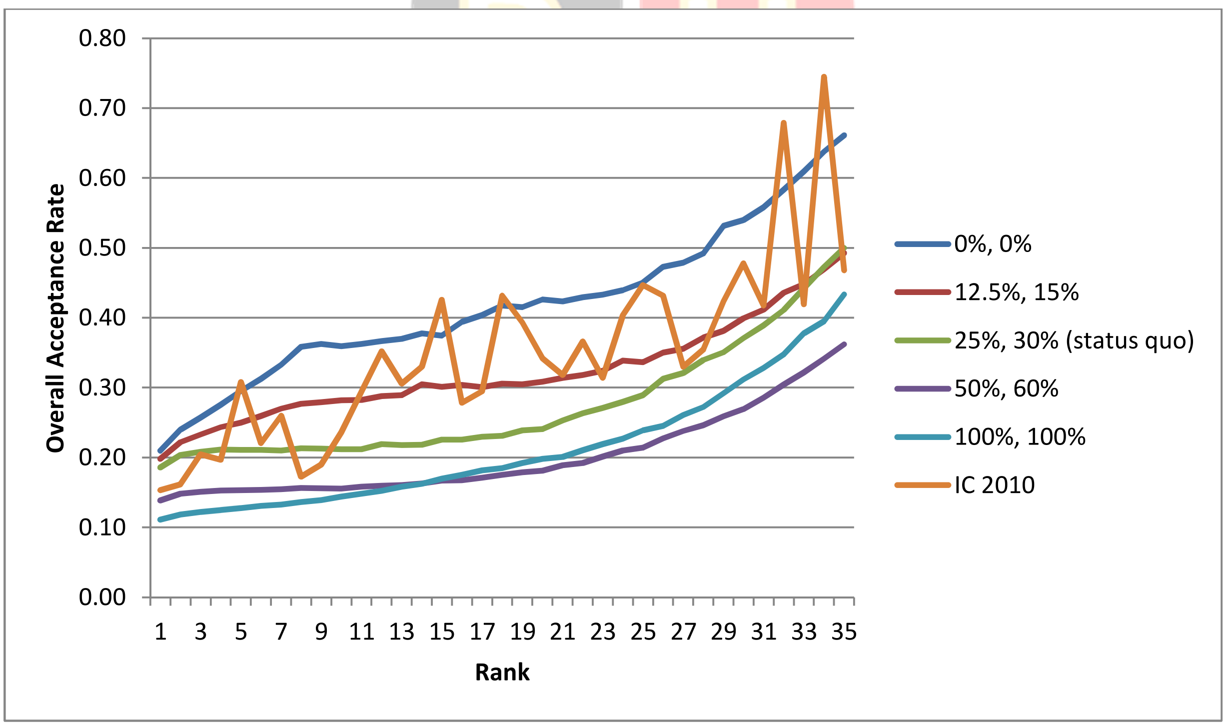

Figure 10. Comparative Overall Acceptance Rates

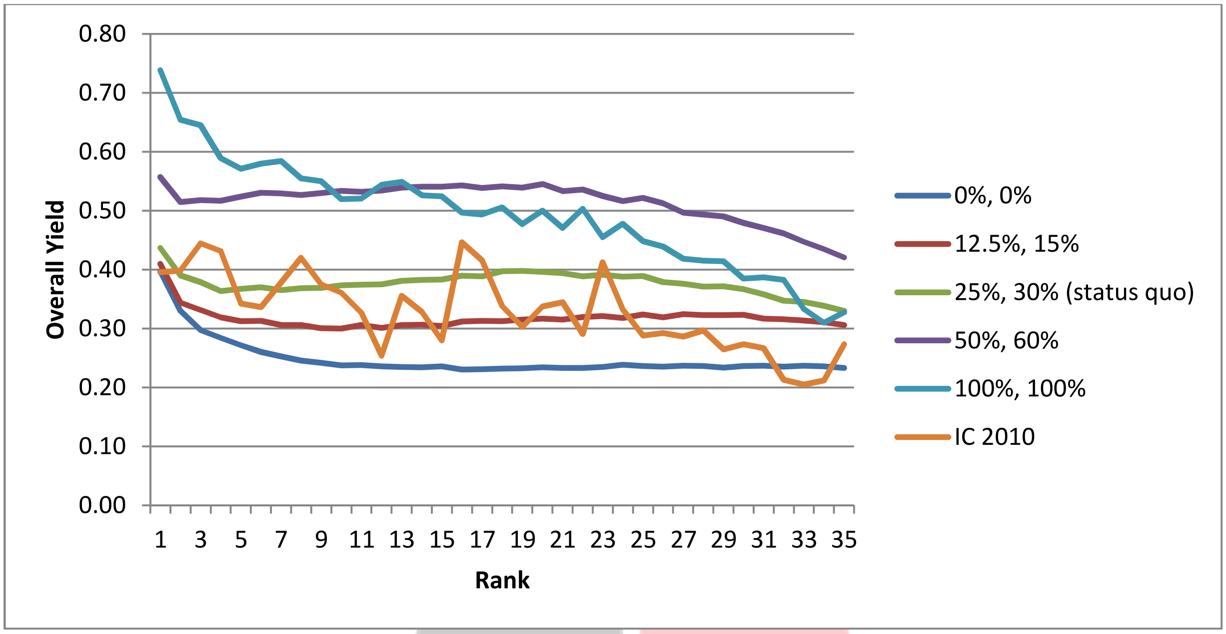

Figure 11. Comparative Overall Yields

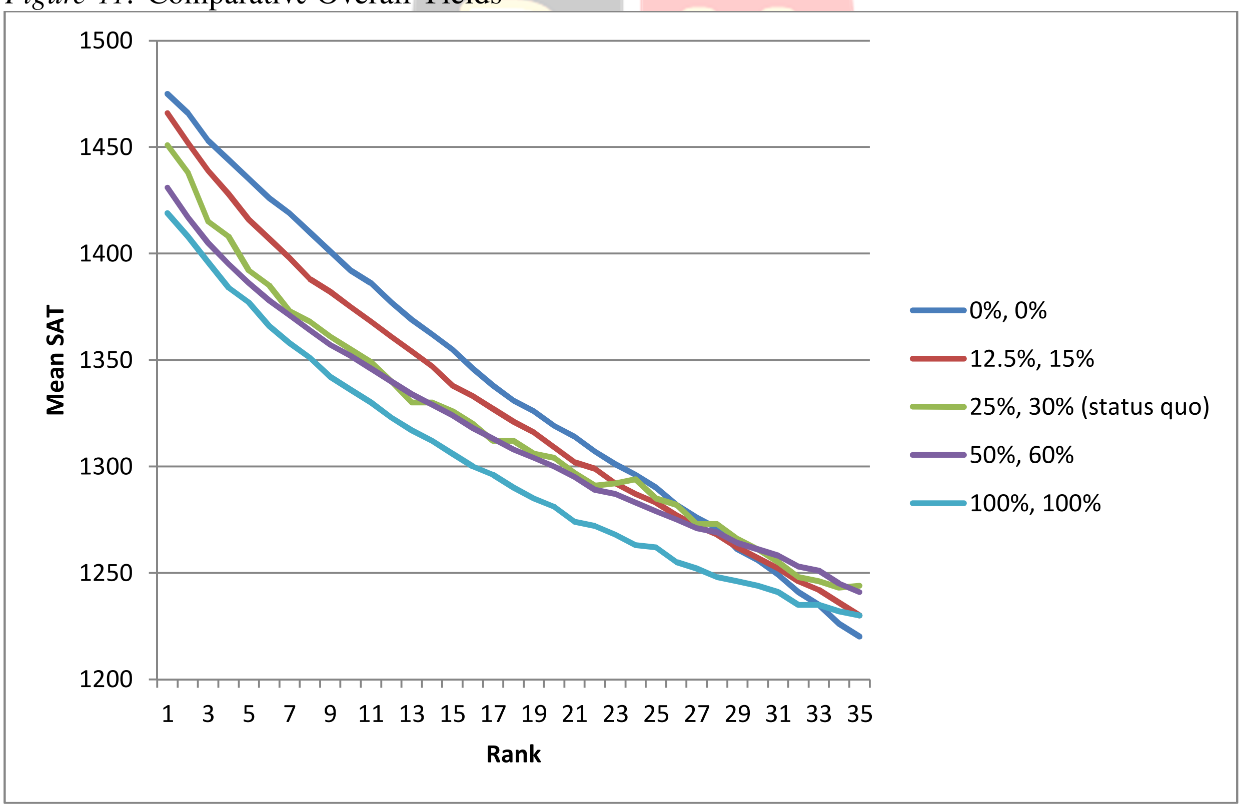

Figure 12. Comparative Mean SAT Score