Admission groups and academic performance: A study of marginal entrants in the selection to higher education

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Abstract

The purpose of this paper is to study whether Swedish admission policies are successful in selecting the best-performing students. The Swedish universities select students based on two different instruments, which each form a separate admission group. A regression model is recommended to estimate the achievement differences for the marginally accepted students between the admission groups and is applied to a sample of 9,024 Swedish university entrants in four different fields of education. Marginally accepted students in the group selected by school grades on average perform better than students accepted by an admission test, suggesting that a small reallocation of study positions towards the grade admission group may increase overall academic achievement. However, the achievement difference appears to vary concerning university programme selectivity. We found that increasing selection by grades in less competitive programmes would improve overall achievement, while increasing selection by grades in highly selective programmes would not increase achievement.

JEL classification: I21, I23, I28

Keywords: Higher education, selection, admission groups, marginal admit, achievement

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1. Introduction

One of the primary goals in higher education admission is to select candidates able to complete courses and obtain their intended university degrees. Therefore, the methods by which candidates are selected are paramount. A fair selection process to higher education studies is often considered synonymous with following a meritocratic principle by which eligible students are allowed to compete for available positions and are judged by the same criteria. The candidates expected to be the most successful are then admitted (Wikström and Wikström 2020; Zwick 2017). This strategy has, however, been challenged because participation in higher education follows social patterns and selection based on meritocratic principles may lead to social bias. Furthermore, the importance of equal opportunity has been more widely recognised (Clancy and Goastellec 2007). To mitigate the social recruitment problem, different policies have been suggested to increase participation in higher education among previously under-represented groups. Affirmative action policies and other forms of preferential treatment have been widely discussed and implemented (see, e.g. Alon and Malamud 2014; Arcidiacono et al. 2015; Arcidiacono and Lovenheim 2016; Bertrand et al. 2010; Conger 2015; Fryer Jr et al. 2008; Zwick 2017). In the present paper, we aim to study the Swedish admission system, where traditional grade-based admissions are complemented by a separate track in which students can gain admission to a university through a general aptitude test.

In the Swedish context, the social recruitment problem was highlighted in the 1960s, and the debate was oriented mainly towards the low participation rates among the working class. In 1977, admission based on upper secondary school grades was complemented by the Swedish Scholastic Aptitude Test (SweSAT). Originally, it was introduced as a second chance for individuals above the age of 25 without competitive grades, and in 1991 it became open to all candidates for selection to higher education (Wedman 2017). The SweSAT is taken voluntarily, and students applying with their SweSAT test scores are placed in a separate SweSAT admission group, distinct from the group in which selections are made based on upper secondary school grades (GPA). Therefore, the SweSAT serves as a second chance for students to compete for positions at universities.[1] A general rule in Swedish admissions is that at least one-third of the students in a programme should be admitted by the SweSAT. The main issues surrounding the use of a policy such as the SweSAT as a separate admission route into university have firstly involved the extent to which the policy can mitigate social bias, and secondly whether the policy affects overall achievement in the higher education system. Wikström and Wikström (2017) studied the SweSAT's potential to reduce social bias by comparing grades and SweSAT scores in two administrations of the

[1] Although admission practices vary greatly among different countries, this is a rarely used approach. One approach common in many countries is to use a combination of multiple instruments (or multiple sources of information) to exploit their respective strengths, while others rely on a single selection instrument, such as secondary school academic performance or national exam scores (Helms 2008, 2009).

SweSAT. The results indicated that men and older test-takers tend to improve their position in the overall ranking of candidates when placed in a test admissions group, while there is little scope for improving the admission possibilities for students with non-traditional backgrounds (low socioeconomic status and non-native students).

Given that the policy of separate admission groups has some potential to improve equality in terms of gender and age, it is of great interest to determine whether such a policy comes at a cost in terms of educational output. We know little about the effects on achievement of offering the SweSAT as a separate admissions track. Previous studies on admission instruments appear to favour GPA over admission tests as a selection instrument, as GPA is a better predictor of academic success (Cerdeira et al. 2018; Cliffordson 2008; Lyrén 2008; Silva et al. 2020; Zwick 2013). Lyrén (2008) summarised ten studies performed on Swedish data and found, among other things, that degree completion rates are higher among students accepted based on GPA. The common explanation for this appears to be that the instruments represent somewhat different constructs, as GPA captures more so-called non-cognitive abilities, and that they represent different forms of assessments (Borghans et al. 2016). Another related study by Murphy and Wyness (2020) explored the UK's application system, in which students apply with examinations grades predicted by the teacher, and found that predicted grades were often inaccurate compared to the actual examination grade.

Other studies have shown that instruments may work differently for different groups of individuals and their efficiency may depend on the purpose of the selection at hand (Gipps and Murphy 1994; Zwick 2002). Sawyer (2007, 2013) discussed the usefulness of selection instruments and showed that universities that differ concerning the 'quality' of applicants may find that scholastic tests and GPA are not equally efficient; admission tests appear favourable in highly competitive environments.

While the previous literature is informative regarding the general functioning of different admission instruments, it is less suitable for discussing the effects of Swedish admission policy on achievement in higher education since it does not address any policy changes. In this paper, we propose a way to study achievement effects by noting that admissions tests and GPA are separate tracks into universities in Sweden and a relevant policy variable is the proportion of study positions that should be allocated through the admissions test group and the proportion that should be allocated through upper secondary school GPA. The main purpose of the present paper is to study whether the allocation of students between the admission groups is promoting the selection of the highest achieving candidates.

Admission and admissions policies are, however, centrally determined in the Swedish higher education system, and it is therefore impossible to exploit variations in admission group sizes to study their achievement effects. To address the admission group size problem, we suggest studying the accepted students at the low end of the distributions in the admission groups. From a policy perspective, given that school performance in upper secondary school should be complemented by a second chance (the SweSAT), this is a relevant strategy since it enables us to study how small changes in the admission groups affect academic performance. By comparing the students from different admission groups at the cut-off (the marginal entrants), the effect of

(marginally) varying group sizes on educational outcomes can be identified. Students are compared at the cut-offs of the admission groups with a regression approach, resembling regression discontinuity, in which the differences in academic performance are estimated for the marginal entrants. The advantage of studying 'marginal reforms' is that small enough changes in admission group sizes would not affect students' incentives. Large reforms to admission group sizes would likely affect the incentives and educational choices at lower levels of education as well as the availability of study positions across university programmes.[2] Therefore, given the selection of students into the admission groups, and the capacity of the admission instruments to pick out the best performing students, the marginal achievement difference is indicative of the direction of a change in the admission group sizes to improve overall academic performance.

Naturally, for such an analysis to be meaningful, the educational programmes under consideration must be competitive in the sense that the selection instruments are applied in the admission process. Therefore, we study four fields of education that are known to have a large number of applicants relative to the number of study positions. Nevertheless, universities and university programmes differ in popularity, meaning that programmes differ in selectivity. We explore the issue of whether selectivity is associated with the marginal achievement difference between admission groups by controlling for the degree of competition for study positions. Thus, our analysis indicates whether it is sensible to use non-uniform admission group rules. Data from Swedish university admissions in the fall semester of 2012 is used, which includes the number of admitted students in different admission groups in the chosen programmes for all universities in Sweden. The outcome variable is a measure of the number of credits achieved after one academic year.

This paper contributes to previous literature in two primary ways. First, it helps determine how varying admission group sizes affect academic achievement. To our knowledge, previous studies on admission group differences have focused on mean achievement differences between groups. While such estimates may be valuable for other purposes, they are not informative when it comes to determining the effects of changing the size of admission groups. Second, this study adds to the limited literature on the preferential treatment of groups by studying marginal admits, similarly to Bertrand et al. (2010) and Bhattacharya et al. (2017). These papers focus on population group differences, while our paper focuses on admission groups. However, since there is a significant difference in how men and women perform on tests and school assessments[3], admission group size is related to access to higher education by gender (Wikström and Wikström 2017). If the majority of the students admitted through the SweSAT are men, decreasing the proportion of students admitted through the SweSAT will increase the gender imbalance in higher education. Then, as noted by Bhattacharya

[2] The effects of admission systems on pre-university human capital accumulation are studied in several papers; see, e.g. Akhtari et al. (2019), Bodoh-Creed and Hickman (2017) Cotton et al. (2014), Grau (2018).

[3] For more studies on gender differences, see, e.g. Aguinis, Culpepper, and Pierce (2016), Conger (2015), Duckworth and Seligman (2006) and Keiser et al. (2016).

et al., an overall achievement increase following such a policy may serve as a measure of the cost of upholding a certain gender balance. Besides contributing to deeper knowledge about admissions mechanisms in the Swedish system, this study's results are also relevant for other countries and educational systems that consider using separate admission groups or separate tracks to select students into higher education.

Section 2 of this paper briefly describes the Swedish admission system and the two main selection instruments. Section 3 describes the empirical research strategy and the data used in the paper, and Section 4 presents the results. Finally, Section 5 provides concluding remarks.

2. The Swedish admission system

The Swedish admissions system is centralised, and students can apply to the universities two times a year through a web-based application site. Admission into a university programme requires students to pass two hurdles. First, students must pass eligibility criteria to prove that they are prepared for higher studies. Eligibility is determined by previous knowledge measured by grades in upper secondary school courses. Some of these requirements are general to all programmes (e.g. basic English and math proficiency), and some are specific to the programme to which a student applies. Second, all eligible students will only be accepted if there are no more eligible applicants than available study positions. For the programmes in which students compete for positions, a selection procedure is applied. Selection is based on two main instruments – the upper secondary school grade point average (GPA) and the score on the Swedish scholastic aptitude test (SweSAT) – as well as a set of rules that the universities must follow, which will be further described when we present the admissions system later in this section.

The basic eligibility requires an upper secondary degree of at least passing grades on 2250 out of 2500 credits and passing grades in Swedish, English and mathematics. There are 18 different upper secondary degrees in Sweden, where six of them focus on general skills and are considered university-preparatory degrees, while the other twelve are vocational degrees. Each degree contains general education courses[4], degree-specific courses and elective courses. The main difference between the general and vocational degrees is that the latter only contains the basic courses in English and Swedish unless these courses are taken as elective courses. A student with a vocational diploma can still apply to higher education if the basic eligibility is met. Moreover, the programmes may also impose specific requirements for eligibility. For example, Engineering programmes require a certain level of mathematics and science to get the specific eligibility.

The grades for each course are determined by the teacher and reported using a lettering system. At the time when most of the individuals included in this study completed their upper secondary education, there were four grades levels: fail (IG),

[4] These courses are Swedish, English, mathematics, history, science, social science, religion and an essay.

pass (G), pass with distinction (VG), and pass with special distinction (MVG).[5] To calculate GPA, the grades are converted to numbers (IG = 0, G = 10, VG = 15, MVG = 20), and each course grade is weighted by the course length to calculate the grade point average. This means that GPA varies between 10 and 20 for a student with passing grades.

The second selection instrument used, the SweSAT, is a norm-referenced, multiple-choice admissions test, intended to measure quantitative and verbal skills regarded as relevant for success in academic studies. In practice, the test is supposed to capture verbal and quantitative skills corresponding to an achievement level in upper secondary school. It contains 160 questions, half of them intended to measure verbal skills and half quantitative skills. The test is administered twice a year, is optional, and individuals can take the SweSAT as many times as they wish. A test result is valid for five years and, if an individual takes the test multiple times, the best result is used for admission. The scores are reported on a normed scale (0.0–2.0), and the test is standardised to be comparable across test administrations. For the sake of simplicity, we scale the SweSAT variable to 0–20 in the upcoming analysis. Both GPA and SweSAT intend to rank students according to abilities that are assumed to be of importance for academic studies.

Unlike many other countries, in Sweden, the two selection instruments are not combined into one measure. Instead, the instruments are used separately in different admission groups. The size of these groups is in part determined by general rules universal among all universities and in part by the universities themselves. Universities are required to use the two main selection instruments. In each programme, at least one-third of the students must be admitted by GPA, and at least one-third by SweSAT. This means that a university can decide which selection instrument to use for one-third of the students in each programme. The exact distribution of study positions between the admissions groups differs between universities and programmes, although many universities choose to admit two-thirds of the student based on GPA and one-third based on the SweSAT. Students can apply with their upper secondary school GPA, but they can also complete their secondary education through 'adult education', either to prove eligibility or to improve competitiveness. Therefore, there are two GPA admission groups, called BI and BII; the BII group contains those who have proven eligibility. Usually, the number of students who apply with proven eligibility is much smaller than without, so relatively few individuals get admitted through group BII.[6]

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[5] In 2012, the number of grades was increased from four to six. The procedure to calculate GPA is the same as described in the text.

[6] The process of allocating study positions between groups is as follows: the numbers of study positions are first allocated between these groups proportionally (e.g. if there are 60 study positions in a programme, the university decides to take two-thirds by GPA, and if one-quarter of the applicants with GPA have proven eligibility, 30 places are allocated to BI and 10 to BII). Then, to give advantage to students who have not received all their grades, one third of the study places are redistributed from group BII to BI, meaning that 33 places are allocated to BI. Additionally, there is a quota group for individuals who have attended folk high schools. The number of students who apply with these merits is, however, very low.

Since students can apply with more than one instrument, they can compete in more than one admission group. This is an incentive to take the SweSAT since it increases the possibility that a student will be admitted to a programme. Students are competing in the group where they are most competitive relative to the other applicants. They must, however, fulfil the basic and specific eligibility for the applied programme regardless of admissions track. In the spring admission of 2012, approximately 65,000 individuals took the SweSAT and in the following fall semester, around 66,000 students applied to university programmes at the bachelor level. Since GPA and SweSAT are the only selection instruments for most programmes, all of the information used in the admission process is fully available to the researcher.

3. Data and method

The empirical analysis in this paper is based on data obtained from the admissions into Swedish universities in the fall semester of 2012 collected by Statistics Sweden (SCB). In this data, information on applicants' GPA and SweSAT scores, as well as the admission group from which they were selected, is included. Applicant data is linked to the achievement of admitted students after the spring semester of 2013 (first-year achievement) and information on which programme and university the students attended. Additionally, we link this data with application data from the Swedish Council for Higher Education to measure competitiveness in different programmes. In the Swedish university system, GPAs are not calculated since there are usually only one or two passing grades. Therefore, the available achievement measure is the number of ECTS credits obtained relative to the number of credits a student signed up for. Definitions of the variables used in the empirical analysis are provided in Table A1 in the Appendix.

Sample

The selection instruments are used for admission to programmes that are oversubscribed in the sense that there are more applicants than available study positions. Some programmes, as well as some individual courses, do not have enough applicants to fill the number of study positions available. Therefore, instead of selecting all university programmes and individual courses, as a first requirement, we select programmes in which we know there is competition for available positions. We study four different fields of education: Business and Economics, Engineering, Law and Social work. We find these particularly useful not only because they are oversubscribed. They also have been running for a long time, are offered at many universities and colleges with similar course contents across universities, and represent different core subject areas. Engineering, Business and Economics and Social work have relatively large programmes in terms of the number of students who participate. Law has fewer students and is only offered at the main universities but is

highly selective.

As mentioned in the previous section, GPA admission is split into two different admission groups depending on whether a student completed their courses at upper secondary (group BI) or have proven eligibility (BII). The number of students with proven eligibility is low; in some programmes with few study positions, the number of entrants from group BII can be as few as one or two. Therefore, we will concentrate this study on comparisons between the SweSAT group and those admitted through the GPA group without proven eligibility. Admitted students are registered at programme start. Some students drop out early within a few weeks of programme start, either because they get admitted to some other programme or for other reasons. We are unable to directly observe dropouts, since universities generally did not unregister students as they quit. To ensure that students participate and do not drop out immediately at programme start, we exclude those who completed zero ECTS credits during the first year.[7] After applying the selection criteria described above, the total number of admitted students included in the empirical analysis is 9,024 across the different fields of education.

The programmes chosen for the present study are generally competitive in the sense that there are more applicants than available study positions. However, descriptive data on university level show heterogeneity in admission scores.[8] One way to distinguish programmes based on attractiveness is to use the number of applicants per study position. The students are allowed to rank up to 20 choices in the application process and therefore the number of first-choice applicants per study position is a better measure to distinguish more or less selective programmes. The numbers of first-choice applicants per study position, available from the official statistics provided by the Swedish Council for Higher Education, are summarised in Table 1.[9] Unsurprisingly, the competition is higher in programmes with relatively few study positions, such as Law programmes, while the larger fields of study have a lower mean number of first-choice applicants and a higher spread among universities. The data on first-choice applicants per position do not include detailed information regarding which admission group the students compete in. This means that the competition for positions can be relatively large in one admission group while there is a lack of eligible students in the other group. For example, Social work has a relatively high number of applicants given that the mean GPA is 16 and the mean SweSAT score is eight. However, none of the other fields differs much in admission scores and are likely to be competitive in both admission groups.

[7] Universities generally did not unregister students any time soon after they quit, meaning that we cannot distinguish non-active students from those with very poor performance. However, full-time studies require 60 ECTS per year, so one ECTS corresponds to approximately half a week of studies, which is a very low requirement in terms of performance.

[8] Descriptive statistics on admission scores by university are presented in Table A2 in the Appendix.

[9] In 2012, a student could apply to a maximum of 20 different programmes or courses. The total number of applicants is, therefore, much higher than the number of first-choice applicants reported in Table 1.

Table 1: The number of first-choice applicants per study position

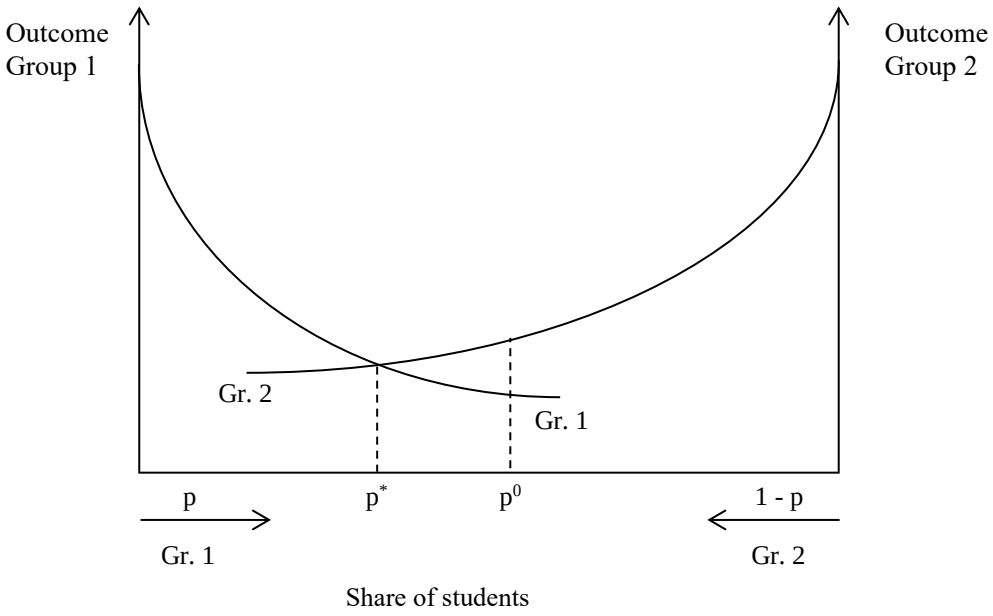
Variable	N	Mean	Std. Dev.	Min	Max
Pooled Data	9,024	2.3	1.69	0.4	7.2
Engineering	4,634	1.5	0.93	0.4	5.9
Business and Economics	2,329	2.5	1.82	0.6	6.2
Social work	1,191	3.4	1.31	1.8	6.5
Law	870	4.8	1.51	2.7	7.2

Note: Mean of first-choice applicants per study position by field of education.

Research strategy

The main idea that we exploit in this paper is that the educational achievement of marginal students of different admission groups will be informative on the direction of a change in the relative group sizes in order to increase overall student achievement. As an example, consider Figure 1. There are two application pools. Applicants are ordered after their expected educational outcome, which is assumed to depend positively on the selection instrument score. Two situations are illustrated. If the share of students admitted in admission group 1 is p^0, the expected marginal outcome is higher in group 2 and admitting one more student in that group (and one less student in group 1) would increase overall achievement. In the other scenario (p^*), one would not be able to tell a direction of change.

Figure 1: An example of marginal achievement differences



Notice that large changes in the admission group sizes would alter application behaviour and other incentives, meaning that the curves drawn in Figure 1 are not stable to large changes in admission group sizes. Nevertheless, we believe that marginal achievement differences between the groups are informative on the question if the overall educational output can be improved upon by a reallocation of students between the admission groups.

Since we are interested in the marginal students, it is important that a reasonable number of admitted students are located relatively close to the cut-off in each of the admission groups. In Figures A1–A5 in the Appendix, the distributions of the scores and GPAs above the cut-off levels are displayed, showing that a large number of individuals are located just above the cut-off. Since the number of marginal students will constitute a very small sample even if one has access to information on a large number of university programmes, the strategy here is to employ a regression framework in which the achievement differences between the marginal students can be estimated. Let *s* and *g* denote the SweSAT test scores and upper secondary school GPAs, respectively. The SweSAT scores and GPAs are assumed to predict academic achievement, *Y*, in the following way:

$$Y_{ij} = DIFFG_j \cdot SATG + f(\tilde{s}_{ij}) \cdot SATG + h(\tilde{g}_{ij}) \cdot GPAG + UNIVFIELD_j + \varepsilon_{ij} \quad (1)$$

where sub index i denotes the individual and j denotes the programme. SATG and GPAG are indicator variables for the SweSAT and GPA groups, respectively. The variables $\tilde{s}$ and $\tilde{g}$ are defined as the relative distances between the individuals' scores and the minimum scores in the programmes, i.e. $\tilde{s}_{ij} = (s_{ij} - s_j^{min})/s_j^{max} - s_j^{min})$ and $\tilde{g}_{ij} = (g_{ij} - g_j^{min})/g_j^{max} - g_j^{min})$, and f and h are functions to be defined below. The functions f and h are modelled such that $f(0) = h(0) = 0$, so evaluating the equation at the marginal entrant ($\tilde{s}_{ij} = s_j^{min}$ or $\tilde{g}_{ij} = g_j^{min}$) is interpreted as the achievement for the marginal entrant. $DIFFG_j$ is the parameter of interest. It measures the achievement difference between the marginal entrant in the SweSAT group and the marginal entrant in the GPA group. We will henceforth denote this as the marginal achievement difference. Several different specifications of the marginal achievement difference will be estimated, and these are discussed in the empirical results section below. Finally, in Equation 1, *UNIVFIELD* is a scalar that represents an effect specific to university and field aimed at capturing differences in course content, level of difficulty, and possibly other differences across universities and field, and is an error term. Note, however, that *UNIVFIELD* only captures university fixed effects when we run field-specific regressions.

The functions f and h capture how expected academic achievement depends on the instruments used in the admission process. We choose to model these as polynomials, $f(\tilde{s}_{ij}) = \sum_{k=1}^{K} \gamma_k (\tilde{s}_{ij})^k$ and $h(\tilde{g}_{ij}) = \sum_{k=1}^{K} \delta_k (\tilde{g}_{ij})^k$. The order of the polynomials, *K*, should be high enough to capture any curvature in the relations between the admission instruments and the outcome variable. Since the choice of *K* is somewhat arbitrary, we estimate models of different orders to make sure that this

choice does not influence the results. To ensure that the estimation strategy employed here is sensible, we will compare estimates in which the full sample of students is used with a restricted sample in which only students from the lower parts of the admission groups distributions are included.

4. Empirical analysis

Data description

Table 2 displays descriptive statistics of admission data for students in the selected programmes. The majority of the 9,024 students were admitted to Engineering, Business and Economics and Social work programmes, with more than 1,000 observations each. Law was the smallest field, with 872 observations, and was only offered at six universities.

The first row in Table 2 shows achievement in the pooled data and by field. On average, students completed 78 per cent of their enrolled credits. Engineering students had the lowest achievement rate (71 per cent) and Social work students had the highest (88 per cent). The second and third rows of Table 2 report mean GPA and SweSAT scores within the respective admission groups. All programmes had relatively high admission scores. The mean GPA scores ranged from around 17.4 to well above 19. This should be compared to the average GPA of students leaving academic track programmes, which is about 15. Average SweSAT scores ranged from a low of 10.7 in Social work programmes to a high of 15.7 in Law. The mean score for all SweSAT test takers was about 10. The gender distribution varied across and within programmes. In general, a larger number of women were admitted by GPA, while men were overrepresented in the SweSAT group. This corresponds with previous studies, which found that men benefit from tests while women have higher grades on average (Fischer, Schult, and Hell 2013; Keiser et al. 2016). A gender imbalance is observed in Engineering, with an overall low proportion of women in both the GPA and SweSAT groups (35 and 16 per cent), while Social work programmes had a very high proportion of women (93 and 73 per cent). The underrepresentation of women in Engineering and overrepresentation of women in Social work is a commonly observed phenomenon (for instance, Fischer (2017), Brenøe and Zölitz (2020) or Mouganie and Wang (2020)).

Summary statistics on other background variables, such as gender, age and family background, are reported in Table A3. Those admitted by SweSAT are somewhat older than the students in the GPA group and we also note a larger standard deviation indicating a larger spread in age among SweSAT students. The overall share of students with a foreign background is relatively low, but having foreign background is less common in the SweSAT group (9 per cent compared to 14 per cent). Further, the social background in terms of parental highest education is, however, very similar between the admission groups.

Table 2: Descriptive statistics

	Pooled data	Engineering	Business and Econ.	Social work	Law
A. Full sample					
Achievement	0.78	0.71	0.81	0.88	0.87
	(0.26)	(0.27)	(0.24)	(0.20)	(0.24)
GPA score	17.91	17.82	17.81	17.4	19.32
	(1.62)	(1.68)	(1.67)	(1.19)	(0.45)
SweSAT score	13.51	14.42	12.51	10.74	15.7
	(3.22)	(2.79)	(3.39)	(2.66)	(1.51)
Prop. SweSAT	0.40	0.38	0.41	0.45	0.43
Women (GPA)	0.53	0.35	0.63	0.94	0.71
Women (SweSAT)	0.30	0.16	0.31	0.73	0.31
Competition	2.32	1.48	2.51	3.45	4.75
	(1.69)	(0.93)	(1.82)	(1.31)	(1.51)
Universities	26	11	19	16	6
Programmes	152	102	26	18	6
N	9,024	4,634	2,329	1,191	870
B. Restricted sample					
Achievement	0.71	0.63	0.76	0.86	0.86
	(0.28)	(0.28)	(0.26)	(0.22)	(0.25)
GPA score	16.80	16.54	16.86	16.17	18.9
	(1.92)	(1.95)	(2.01)	(0.94)	(0.33)
SweSAT score	12.35	13.17	11.25	8.78	14.83
	(3.27)	(2.82)	(3.51)	(1.97)	(1.05)
Prop. SweSAT	0.54	0.52	0.52	0.56	0.61
Women (GPA)	0.49	0.33	0.53	0.92	0.73
Women (SweSAT)	0.30	0.16	0.33	0.77	0.31
Competition	2.42	1.57	2.63	4.70	3.48
	(1.74)	(1.04)	(1.89)	(1.56)	(1.32)
Universities	26	11	19	16	6
Programmes	152	102	26	18	6
N	2,650	1,369	652	331	298

Note: Achievement is the proportion of accomplished courses in relation to enrolled courses. The GPA score and SweSAT score display mean values in the admission groups. Prop. SweSAT reports the share of students admitted by the SweSAT, and Women (GPA)/(SweSAT) shows the gender distribution in each admission group. Competition is the number of first-hand applicants per study position. Universities denotes the number of distinct universities in each field of education. Standard deviations are reported in parentheses.

As mentioned in Section 3, the results from the full sample are compared to a sample of students from the lower parts of the admission groups. For each of the programmes observed in the data, the 20 per cent with the lowest scores in the GPA and SweSAT admission groups are selected. When constructing this sample, we decided to include ties, so the number of individuals included from the SweSAT group in most programmes exceeds 20 per cent, since the SweSAT scores are reported in unit intervals. Therefore, the proportion of students admitted via SweSAT is larger in the restricted sample than in the full sample. Table 3 reports descriptive statistics from the restricted sample. The mean achievement at the bottom of the score distributions is 2 to 9 percentage points lower than in the full sample. The mean scores in both GPA and SweSAT are between 0.4 and 1.3 units lower than in the full sample, except for the SweSAT scores in the Social work programme, where the average score is nearly two units lower. As in the full sample, the gender distribution varies across programme and admission groups. Still, more men than women enrolled in Engineering programmes and mainly female students enrolled in Social work programmes.

Table 3: Mean achievement in each admission group

	SweSAT			GPA			Mean
	Mean	SD	N	Mean	SD	N	diff.
A. Full sample							
Pooled data	0.729	0.281	3,645	0.807	0.246	5,379	-0.077*
Engineering	0.657	0.283	1,775	0.749	0.261	2,859	-0.092*
Business and Econ.	0.762	0.266	965	0.841	0.221	1,364	-0.080*
Social work	0.846	0.229	533	0.913	0.168	658	-0.067*
Law	0.825	0.271	372	0.904	0.210	498	-0.079*
B. Restricted sample							
Pooled data	0.693	0.292	1,418	0.737	0.273	1,232	-0.044*
Engineering	0.599	0.284	710	0.655	0.280	659	-0.056*
Business and Econ.	0.726	0.283	342	0.790	0.235	310	-0.064*
Social work	0.842	0.239	185	0.880	0.197	146	-0.038
Law	0.844	0.248	181	0.880	0.247	117	-0.036

Note: Mean diff. reports the average difference between SweSAT- and GPA-admitted students. An asterisk indicates that the mean difference is significant at the five per cent level.

Estimation results

We first present results based on data pooled from all fields of education. As mentioned above, the regression equation is estimated for the full and restricted samples. To determine the polynomial order of the functions *f* and *h* in equation (1), F-tests are performed. The tests are conducted on the full sample. We start by estimating models with the polynomial order of *K=3*, and then reduce the polynomial order. An order of $K = 2$ cannot be rejected, while a linear specification (*K=1*) is marginally rejected. However, the estimates do not differ considerably between the linear and quadratic specification of K. Therefore, we only present the results from the quadratic specification.

Of primary interest here is the marginal achievement difference (the term DIFFG in equation 1). Our baseline estimates of DIFFG represents the case where we assume a constant (homogenous) marginal achievement, which we will denote Model 1. As shown in Table 1, university programmes are differently selective in terms of the number of applicants, and academic achievement in the two admission groups ultimately depends on the competition for study positions within the groups. In less selective programmes, the number of applicants with SweSAT scores tend to be low since there is less need to improve one's position relative to the GPA ranking to be admitted. This means that low achievers have a better likelihood of gaining admittance to a less selective programme if they take the SweSAT. In highly selective programmes, on the other hand, competition is likely to be fierce in both admission groups. This suggests that one should distinguish programmes based on the number of applicants in the admission groups to control for heterogeneity in marginal achievement differences across programmes. Unfortunately, we cannot determine the number of applicants in the different admission groups. Instead, the number of first-choice applicants per study position is used to capture programme competition.

We estimate two alternative models, assuming that the marginal achievement differences interact with the competition for study positions. In a second specification (Model 2), the competition for study positions is accounted for by interacting the SweSAT indicator variable with a polynomial of the number of first-choice applicants per study position according to $DIFFG_j = \alpha + \beta_1 APPLICANTS + \beta_2 APPLICANTS^2$. In a third specification (Model 3), categorical variables are created based on programme competition. We distinguish between LOW, MEDIUM and HIGH competition programmes, where LOW competition programmes refer to those in which the number of first-choice applicants (per study position) is less than two, MEDIUM refers to programmes with two to four first-choice applicants, and HIGH refers to programmes with more than four first-choice applicants; i.e. $DIFFG = \theta_1 LOW + \theta_2 MEDIUM + \theta_3 HIGH$.

The results are reported in Table 4. Panel A of the table displays the results based on the full sample and Panel B presents the results based on the restricted sample. In the first column, a constant marginal achievement effect is assumed. The

average achievement difference for a marginal admit is 3 percentage points (full sample) and 5 percentage points (restricted sample) higher for a GPA admit. Allowing for a competition effect in Model 2, we note that the linear term has a positive effect and the quadratic term has a negative effect. In the least competitive programmes included in the data, where the number of first-choice applicants per study position is about 0.5, Model 2 implies that the marginal GPA admit has a 6 and 11 percentage points higher level of academic achievement based on the estimates of the full and restricted samples, respectively. However, competition seems to affect achievement, as a unit increase in the number of first-choice applicants correlates to a three percentage point relative increase in the achievement of the marginal admitted SweSAT student in the full sample and a 6.5 percentage point increase in the restricted sample. This suggests that there is an initial negative achievement difference in less competitive programmes, but this achievement difference shrinks when the number of applicants increases.

The numbers presented in Column 2 of Table 4 illustrates that the estimated marginal achievement difference approaches zero if the number of first-choice applicants is approximately three. Evidence in favour of heterogeneity regarding the marginal achievement difference is further strengthened by the estimates of the categorical model (Model 3). In the low competition programmes, there is a clear negative effect, while in medium and high competition programmes, the effects are small and statistically insignificant. Although the main focus is on admission groups and not gender differences, we notice that separate regressions for men and women (not reported in this study) yield similar results as the general model.[10] Overall, GPA admitted performs better than the SweSAT group and there is no distinct difference between men and women. There are, however, fewer observations in these gender-specific regressions and the significance level varies across gender and field.

Moreover, as a concluding robustness check, we include controls for social background in our model. Previous literature has shown that gender and family background are important in predicting academic achievement at the upper secondary- and university level (Thiele et al. 2016; Wikström and Wikström 2017). Thus, we include gender, age, foreign background and parental highest education in our model. However, the achievement differences do not change when we introduce additional controls for socioeconomic background, indicating that the main results are robust against changes in the model specification (see Table A4). This suggests that socioeconomic background does not have any important role in explaining the marginal achievement differences. Given that the groups are relatively similar in most of these background variables (see Table A3), the finding is perhaps not surprising.

[10] The results from gender-specific regressions are available upon request from the authors.

Table 4: Estimated marginal achievement differences based on pooled data

	Model 1 (Constant)	Model 2 (Quadratic)	Model 3 (Categorical)
A. Full sample			
Intercept	-0.029*	-0.077***	
	(0.015)	(0.027)	
Competition		0.032*	
		(0.017)	
Competition squared		-0.003	
		(0.002)	
Competition: LOW			-0.046***
			(0.017)
Competition: MEDIUM			-0.012
			(0.017)
Competition: HIGH			0.002
			(0.016)
R-squared	0.166	0.167	0.168
B. Restricted sample			
Intercept	-0.048**	-0.143***	
	(0.017)	(0.040)	
Competition		0.066**	
		(0.028)	
Competition squared		-0.007*	
		(0.004)	
Competition: LOW			-0.073***
			(0.020)
Competition: MEDIUM			-0.024
			(0.024)
Competition: HIGH			0.005
			(0.031)
R-squared	0.187	0.192	0.191

Note: Parameters of the term DIFFG are displayed in the table. Standard errors are clustered at programme level and reported within parentheses. Significance levels are denoted by asterisks, where *** is significant at the 1 per cent level, ** at the 5 per cent level and * at the 10 per cent level. The order of the polynomials $f(\cdot)$ and $h(\cdot)$ is $K = 2$. Field fixed effects and university fixed effects are included in the estimation. The number of observations is 9,024 (full sample) and 2,650 (restricted sample).

Based on the pooled regressions, it appears that there is a negative marginal achievement difference, although the difference is only sizeable in programmes where the competition for study positions is relatively low. A natural next step is to study the achievement differences within the fields of education to see if this pattern persists or if it is an artefact of the composition of programmes in the data set. Table 5 reports

estimation results for each field separately. Two model specifications are presented: the constant model (Model 1) and the categorical model (Model 3).

Table 5: Marginal achievement differences; Field-specific estimates

	Model 1 (Constant)	Model 3 (Categorical)		
	Intercept	LOW	MEDIUM	HIGH
A. Full sample				
Engineering	-0.035*	-0.045*	0.006	-0.001
(N = 4,634)	(0.021)	(0.024)	(0.024)	(0.030)
Business and Economics	-0.050***	-0.069**	-0.017	-0.020
(N = 2,329)	(0.021)	(0.027)	(0.031)	(0.026)
Social work	-0.038	-0.027	-0.053	-0.010
(N = 1,191)	(0.039)	(0.037)	(0.041)	(0.035)
Law	0.029	N.A.	0.024	0.034
(N = 870)	(0.057)		(0.047)	(0.067)
B. Restricted sample				
Engineering	-0.044*	-0.062***	0.031	0.032
(N = 1,369)	(0.025)	(0.027)	(0.033)	(0.039)
Business and Economics	-0.067**	-0.071*	-0.072	-0.057
(N = 652)	(0.032)	(0.031)	(0.055)	(0.036)
Social work	-0.044	-0.045	-0.073	0.004
(N = 331)	(0.047)	(0.072)	(0.057)	(0.046)
Law	-0.006	N.A.	-0.040	0.032
(N = 298)	(0.027)		(0.021)	(0.044)

Note: Parameters of the term DIFFG are displayed in the table. Standard errors are clustered at programme level and reported within parentheses. Significance levels are denoted by asterisks, where *** is significant at the 1 per cent level, ** at the 5 per cent level and * at the 10 per cent level. The order of the polynomials $f(\cdot)$ and $h(\cdot)$ is $K = 2$. University fixed effects are included in the estimation.

In Model 1, the marginal achievement difference is negative and statistically significant for the Business and Economics programmes, weakly significant for Engineering, negative and non-significant for Social work and positive and non-significant for Law. Controlling for competition, there is a general pattern in most point estimates for the different fields similar to the findings from the pooled data. The achievement differences in Engineering are negative and significant in low competition programmes in both samples (although weakly significant in the full sample). In high competition programmes, the differences are generally small, varying in sign and estimated with low precision. Concerning the sign of the parameter estimates, we also note some differences, however. Most notably, in Social work, the achievement

difference is negative and relatively large in medium competition programmes. Most Social work programmes are considered here as either medium or high competition programmes. However, as was mentioned in Section 3, and considering the score and grade of the marginal admit within the Social work programmes (see Table A5), we note that the marginal SweSAT score is generally low, meaning that it is (often substantially) below the average score of SweSAT test takers (which is around 10), while the grade point averages of the marginal admits in the GPA group are most often near or above the national average (which is approximately 15). Therefore, one may surmise that the competition for study positions varies between the admission groups in a way that is not easily captured by the measure of competition used in this paper.

To address the issue of differences in competition between admission groups, we compare our results with regressions in which programmes with relatively low admission scores are excluded, since low admission scores may indicate poor competition for study positions, especially in the SweSAT admission group. As a criterion for selection, programmes in which the marginal admit has a GPA or SweSAT score below the national averages are excluded (a GPA lower than 15 or a SweSAT score below 10). The Law programmes will not be affected by this criterion since the admission scores are always above the averages, but the number of programmes retained otherwise differs between the fields of education. Furthermore, most Social work programmes are excluded from the analysis by this procedure since marginal admissions scores are generally below ten among these students. Performing the additional analysis does not alter the main results in any important way, and the results can be found in Table A5 in the Appendix. Although this is a crude way to capture differences in competition between the groups, it suggests that the main results are not driven by varying competition between the admission groups.

One potential explanation of the results regarding competition for study positions is that the two instruments used in admissions to some extent reflect different constructs. As discussed in the introduction, besides the differences in format, grades are generally considered a better measure of non-cognitive abilities than tests. If such competencies are important in higher studies, then GPA is a better predictor of academic achievement. To determine whether competition for study positions is associated with the quality of students, under the assumption that GPA is a superior admission instrument, we run an auxiliary regression on a sample of students admitted by the SweSAT. The dependent variable is GPA, we control for the SweSAT score and the categorical variables reflect competition and effects specific to university and fields of education. Then, conditional on the SweSAT score, we study whether the GPA differs regarding competition.[11] The results suggest that there is a small difference between high competition programmes and low competition programmes, but this difference is not statistically significant. However, we cannot dismiss the explanation that small marginal achievement differences in high

[11] The regression is performed on SweSAT admitted students (N = 3,277; $R^2 = 0.34$). The estimated equation is: $GPAscore = \underset{(0.43)}{11.28} + \underset{(0.02)}{0.35} \times SweSATscore - \underset{(0.28)}{0.46} \times LOW + \underset{(0.30)}{0.08} \times MEDIUM + OTHERVAR$.

competition programmes indicate that admitted students in those programmes have gained better non-cognitive abilities than students in low competitive programmes.

5. Concluding remarks

The Swedish admission process involves two main routes by which a prospective student can gain access to higher education: upper secondary school GPA and the SweSAT. Simple comparisons of success rates between the admission groups formed by students applying with these instruments are difficult to interpret because of selection effects. To compare the admission groups, we suggest comparing the marginally admitted students. If the marginally admitted students in one admission group outperform the marginally admitted students in the other group, then reallocating study positions between the admission groups may increase overall achievement.

The four fields of education used in the empirical analysis represent an important segment of undergraduate university education in Sweden. After pooling the data from the four fields, our basic finding is that the marginal students accepted by the SweSAT on average complete 3 to 5 percentage points fewer ECTS credits of those they register for during first-year studies compared to the marginal students in the GPA group. The academic year is 40 weeks, so these figures equal approximately one to two weeks of full-time studies. Thus, it appears that a potential gain in overall educational achievement can be made by (marginally) adjusting the size of the admission groups to accept a larger proportion of students from the GPA group. Equally important, we demonstrate that the marginal achievement differences are large in less selective programmes and tend towards zero in programmes in which there is fierce competition for the available study positions. This suggests that a uniform policy regarding admission group sizes may not be as effective in terms of overall educational achievement as a non-uniform policy.

Using the number of first-choice applicants to measure selectivity into university programmes may serve as a beneficial first approximation to increase understanding of how selection effects influence the observed group differences. To further pursue the idea that the admission group differences that we observed depend on the composition of the applicants, one must include programme-specific information regarding the number of applicants in each admission group. Using application data, one can study how selectivity affects the group differences more precisely than we have been able to in this paper.

References

Aguinis, Herman, Steven A Culpepper, and Charles A Pierce. 2016. 'Differential Prediction Generalisation in College Admissions Testing.' *Journal of Educational Psychology* 108(7): 1045.

Akhtari, Mitra, Natalie Bau, and Jean-William Laliberte. 2019. 'Affirmative Action and Pre-College Human Capital'. *NBER Working Paper*.

Alon, Sigal, and Ofer Malamud. 2014. 'The Impact of Israel's Class-Based Affirmative Action Policy on Admission and Academic Outcomes'. *Economics of Education Review* 40: 123–39.

Arcidiacono, Peter, and Michael Lovenheim. 2016. 'Affirmative Action and the Quality-Fit Trade-Off'. *Journal of Economic Literature* 54(1): 3–51.

Arcidiacono, Peter, Michael Lovenheim, and Maria Zhu. 2015. 'Affirmative Action in Undergraduate Education'. *Annu. Rev. Econ.* 7(1): 487–518.

Bertrand, Marianne, Rema Hanna, and Sendhil Mullainathan. 2010. 'Affirmative Action in Education: Evidence from Engineering College Admissions in India'. *Journal of Public Economics* 94(1–2): 16–29.

Bhattacharya, Debopam, Shin Kanaya, and Margaret Stevens. 2017. 'Are University Admissions Academically Fair?' *Review of Economics and Statistics* 99(3): 449–64.

Bodoh-Creed, Aaron, and Brent Richard Hickman. 2017. 'Pre-College Human Capital Investments and Affirmative Action: A Structural Policy Analysis of US College Admissions'. *Becker Friedman Institute for Research in Economics Working Paper* (2017–10).

Borghans, Lex, Bart HH Golsteyn, James J Heckman, and John Eric Humphries. 2016. 'What Grades and Achievement Tests Measure'. *Proceedings of the National Academy of Sciences* 113(47): 13354–59.

Brenøe, Anne Ardila, and Ulf Zölitz. 2020. 'Exposure to More Female Peers Widens the Gender Gap in Stem Participation'. *Journal of Labor Economics* 38(4): 1009–54.

Cerdeira, José Miguel, Luis Catela Nunes, Ana Balcão Reis, and Carmo Seabra. 2018. 'Predictors of Student Success in Higher Education: Secondary School Internal Scores versus National Exams'. *Higher Education Quarterly* 72(4): 304–13.

Clancy, Patrick, and Gaële Goastellec. 2007. 'Exploring Access and Equity in Higher Education: Policy and Performance in a Comparative Perspective'. *Higher Education Quarterly* 61(2): 136–54.

Cliffordson, Christina. 2008. 'Differential Prediction of Study Success across Academic Programs in the Swedish Context: The Validity of Grades and Tests as Selection Instruments for Higher Education'. *Educational Assessment* 13(1): 56–75.

Conger, Dylan. 2015. 'High School Grades, Admissions Policies, and the Gender Gap in College Enrollment'. *Economics of Education Review* 46: 144–47.

Cotton, Christopher, Brent Richard Hickman, and Joseph Price. 2014. 'Affirmative Action and Human Capital Investment: Evidence from a Randomized Field Experiment'. *NBER Working Paper* (w20397).

Duckworth, Angela Lee, and Martin EP Seligman. 2006. 'Self-Discipline Gives Girls the Edge: Gender in Self-Discipline, Grades, and Achievement Test Scores.' *Journal of educational psychology* 98(1): 198.

Fischer, Franziska T, Johannes Schult, and Benedikt Hell. 2013. 'Sex-Specific Differential Prediction of College Admission Tests: A Meta-Analysis.' *Journal of Educational Psychology* 105(2): 478.

Fischer, Stefanie. 2017. 'The Downside of Good Peers: How Classroom Composition Differentially Affects Men's and Women's STEM Persistence'. *Labour Economics* 46: 211–26.

Fryer Jr, Roland G, Glenn C Loury, and Tolga Yuret. 2008. 'An Economic Analysis of Color-Blind Affirmative Action'. *The Journal of Law, Economics, & Organization* 24(2): 319–55.

Gipps, Caroline V, and Patricia Murphy. 1994. *A Fair Test? Assessment, Achievement and Equity.* Open University Press.

Grau, Nicolás. 2018. 'The Impact of College Admissions Policies on the Academic Effort of High School Students'. *Economics of Education Review* 65: 58–92.

Helms, R.M. 2008. 'University Admissions Worldwide'. *Education Working Paper Series* 15.

———. 2009. 'University Admissions: Practices and Procedures Worldwide'. *International Higher Education* (54): 5–7.

Keiser, Heidi N, Paul R Sackett, Nathan R Kuncel, and Thomas Brothen. 2016. 'Why Women Perform Better in College than Admission Scores Would Predict: Exploring the Roles of Conscientiousness and Course-Taking Patterns.' *Journal of Applied Psychology* 101(4): 569.

Lyrén, Per-Erik. 2008. 'Prediction of Academic Performance by Means of the Swedish Scholastic Assessment Test'. *Scandinavian Journal of Educational Research* 52(6): 565–81.

Mouganie, Pierre, and Yaojing Wang. 2020. 'High-Performing Peers and Female Stem Choices in School'. *Journal of Labor Economics* 38(3): 805–41.

Murphy, Richard, and Gill Wyness. 2020. 'Minority Report: The Impact of Predicted Grades on University Admissions of Disadvantaged Groups'. *Education Economics* 28(4): 333–50.

Sawyer, Richard. 2007. 'Indicators of Usefulness of Test Scores'. *Applied Measurement in Education* 20(3): 255–71.

———. 2013. 'Beyond Correlations: Usefulness of High School GPA and Test Scores in Making College Admissions Decisions'. *Applied measurement in education* 26(2): 89–112.

Silva, Pedro Luis et al. 2020. 'Student Selection and Performance in Higher Education: Admission Exams vs. High School Scores'. *Education Economics*: 1–18.

Thiele, Tamara, Alexander Singleton, Daniel Pope, and Debbi Stanistreet. 2016. 'Predicting Students' Academic Performance Based on School and Socio-Demographic Characteristics'. *Studies in Higher Education* 41(8): 1424–46.

Wedman, Jonathan. 2017. 'Theory and Validity Evidence for a Large-Scale Test for Selection to Higher Education'. Umeå universitet.

Wikström, Christina, and Magnus Wikström. 2017. 'Group Differences in Student Performance in the Selection to Higher Education: Tests vs Grades'. In Frontiers, 45.

———. 2020. 'Merit-Based Admissions in Higher Education'. In *Higher Education Admissions Practices: An International Perspective*, Educational and Psychological Testing in a Global Context, eds. Cathy Wendler and María Elena Oliveri. Cambridge: Cambridge University Press, 34–50. https://www.cambridge.org/core/books/higher-education-admissions-practices/meritbased-admissions-in-higher-education/5446229184EE4718C20FE7ABC2DB4EBF.

Zwick, Rebecca. 2002. *Fair Game?: The Use of Standardized Admissions Tests in Higher Education*. Psychology Press.

———. 2013. 'Disentangling the Role of High School Grades, SAT® Scores, and SES in Predicting College Achievement'. *ETS Research Report Series* 2013(1): 1–20.

———. 2017. *Who Gets In? : Strategies for Fair and Effective College Admissions*. Harvard University Press.

Appendix A

The following figures, A1–A5, illustrates the proportions of students in relation to the cut-off for each field of education. The x-axis shows the functions *f* and *h* for each student (see Equation 1). To make the upper secondary school GPA and SweSAT comparable, the variables s and g are defined as the relative distances between the individuals' scores and the minimum scores in the programmes.

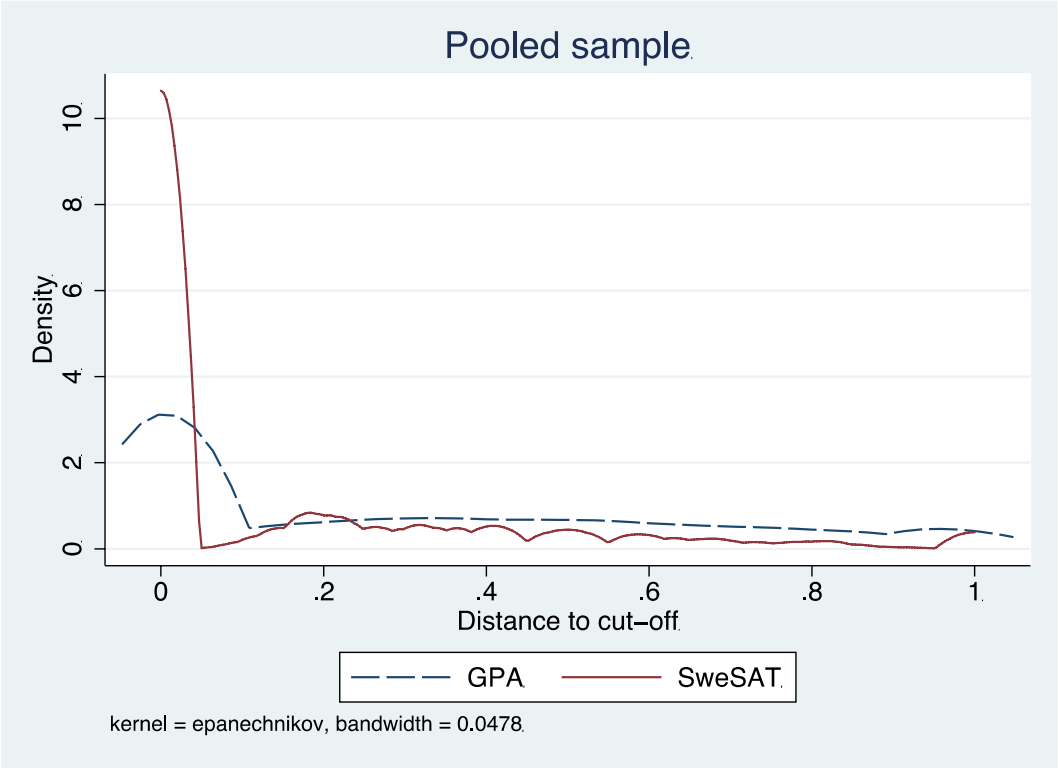


Figure A1

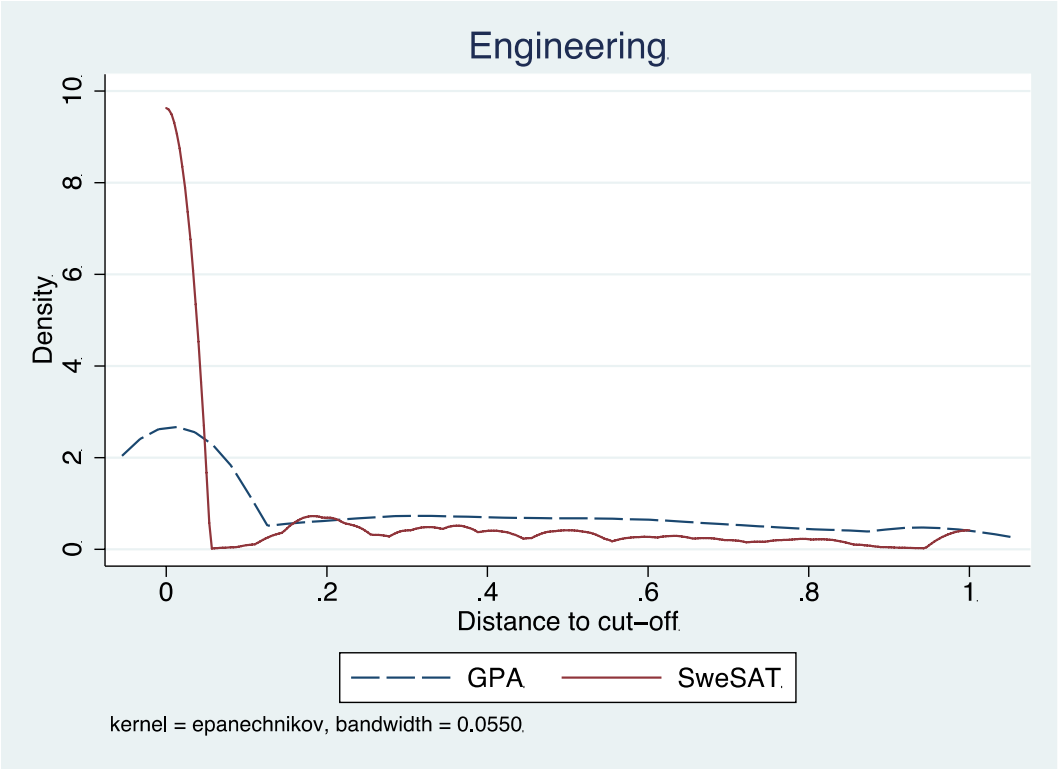


Figure A2

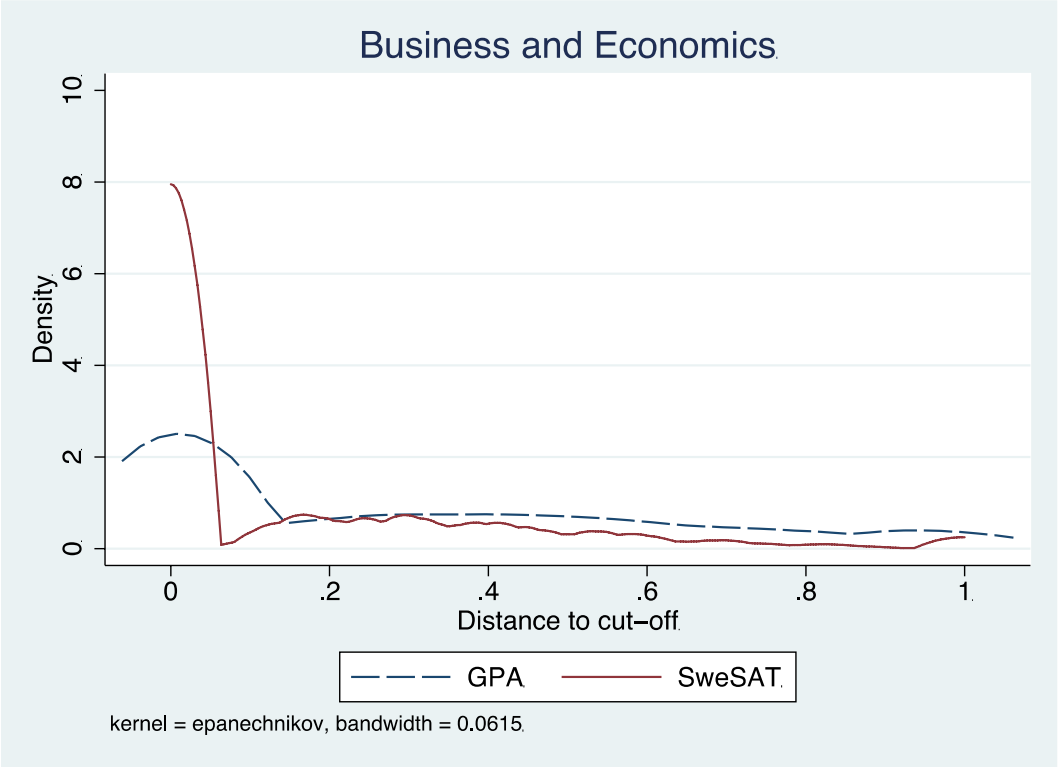


Figure A3

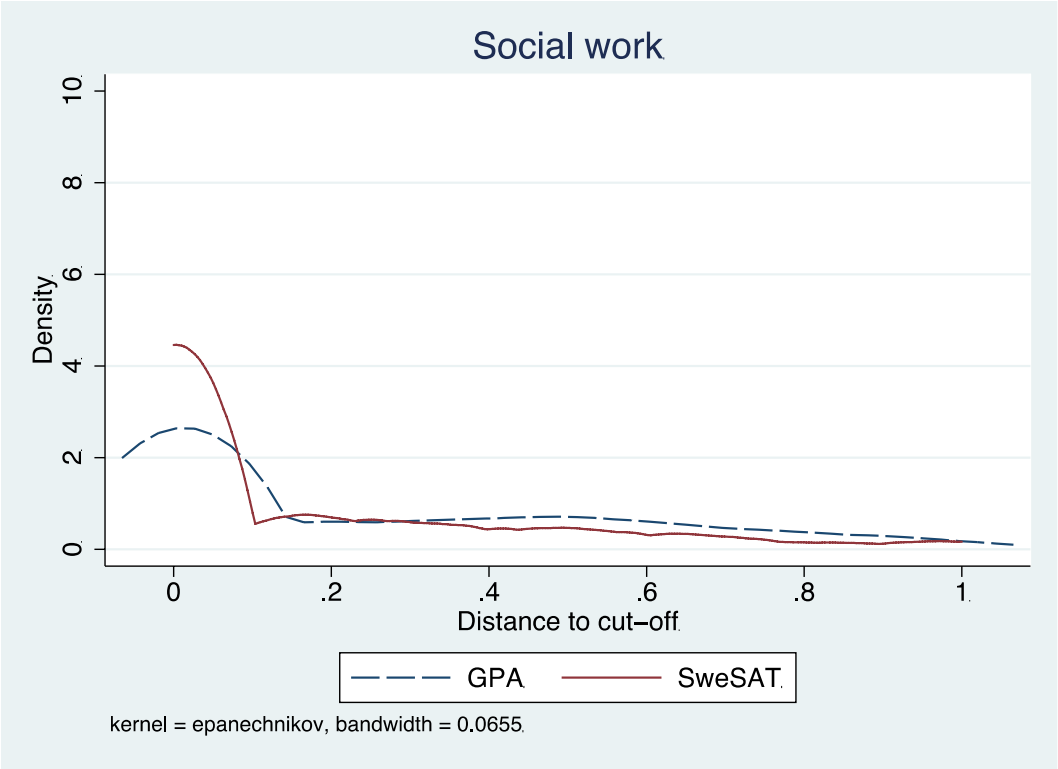


Figure A4

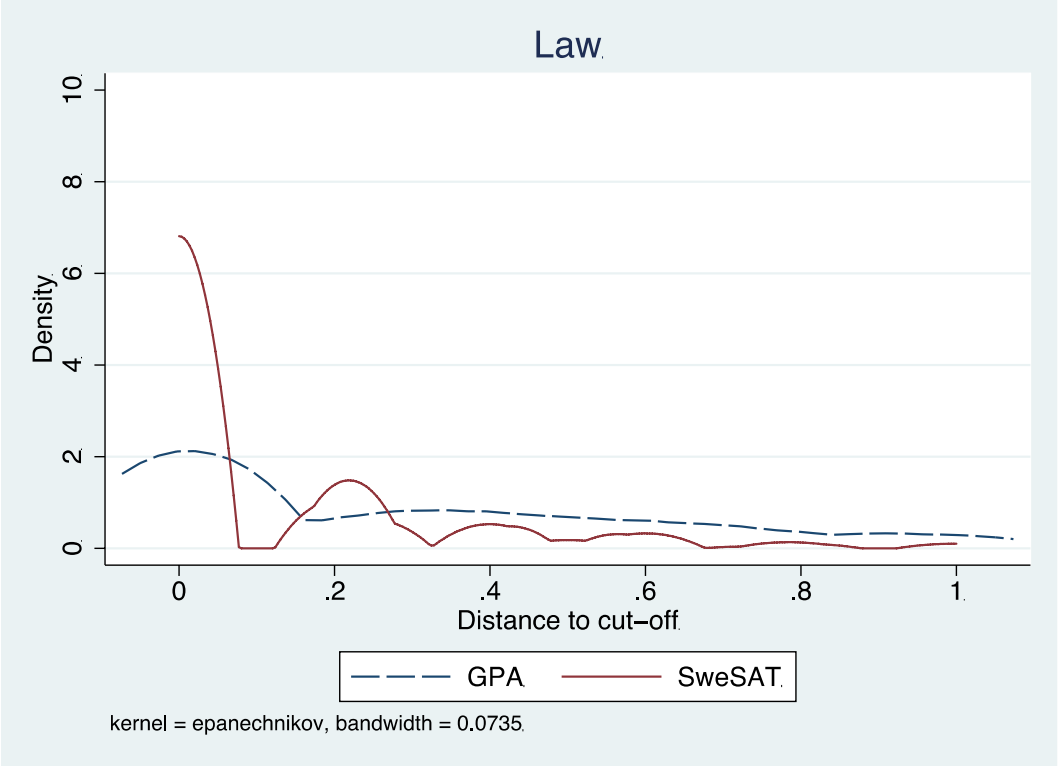


Figure A5

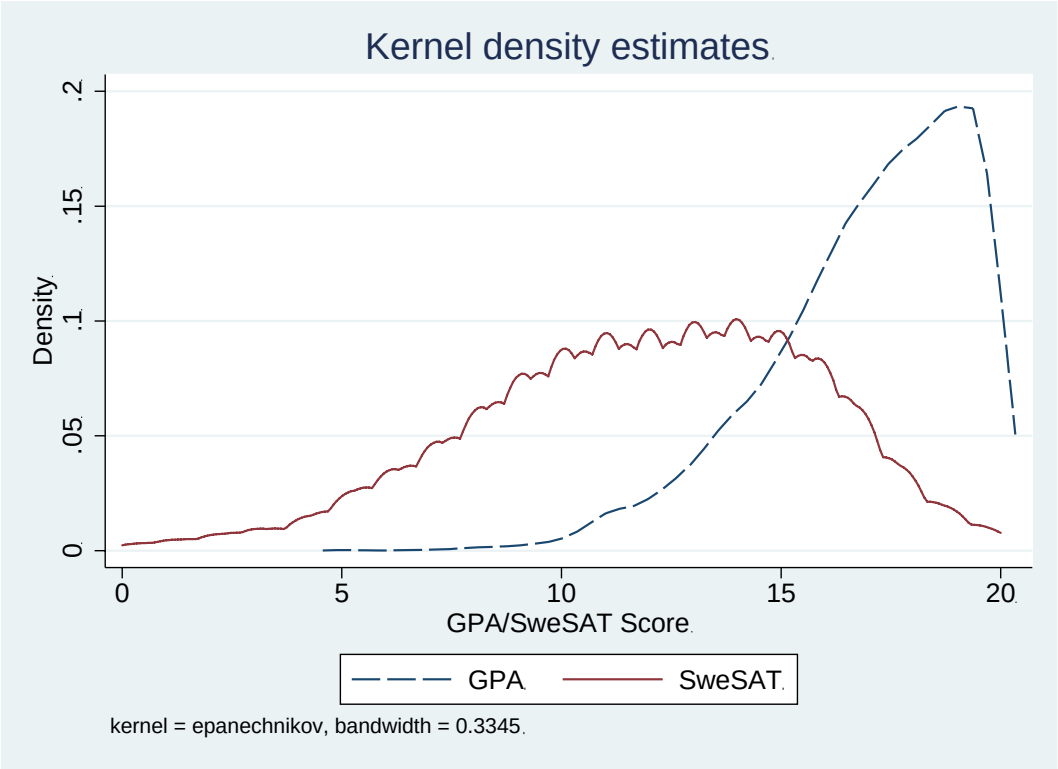


Figure A6: Distribution of admission scores in pooled sample unconditioned on admission group.

Table A1: List of variables available in the datasets

Variable name	Description	Source
Student ID	Student's ID	The national education records, 2012/2013
Age	Student's age in the year of 2012.	The national education records, 2012/2013
Gender (woman)	A dummy variable taking the value one if the student is female.	The national education records, 2012/2013
Immigrant background	A dummy variable taking the value one if at least one of the student's parents is born outside Sweden.	The national education records, 2012/2013
Parental highest education	Dummy variables taking the value of one if the parent with the highest education level is 9 years of schooling; two if the highest educational level is at upper secondary level or three if the highest educational level is at post-secondary level.	The national education records, 2012/2013
GPA	Student's upper secondary school GPA.	The national education records, 2012/2013
SweSAT	Student's SweSAT score.	The national education records, 2012/2013
Admissions group	Dummy variables indicating the student's admissions group. Students admitted by other instruments than GPA or SweSAT are excluded.	The national education records, 2012/2013
University ID	ID for each university.	The national education records, 2012/2013

Programme ID	ID for each programme.	The national education records, 2012/2013
Completed credits	Student's completed credits in the academic year of 2012/2013. Students with zero completed credits are excluded from the analysis.	The national education records, 2012/2013
Enrolled credits	Student's enrolled credits in the academic year of 2012/2013.	The national education records, 2012/2013
First-choice applicants	The number of first-choice applicants per programme.	National admissions records, UHR, 2012
Number of admitted applicants	The number of admitted students per programme. Since all programmes in this study are oversubscribed, the variable serves as a proxy of available spots.	National admissions records, UHR, 2012
Transformed variables		
Achievement	Achievement is defined as the fraction of completed credits over enrolled credits.	
$\tilde{s}$	$\tilde{s}$ is defined as the relative distance from the student's SweSAT to the minimum score in the programme. i.e. the admissions score from the last admitted student subtracted from the student's admission score divided by the range between the highest and lowest admissions score.	
$\tilde{g}$	$\tilde{g}$ is defined as the relative distance from the student's GPA to the minimum score in the programme.	
FIELD	Dummy variables for each field (Engineering, Business and Economics, Law and Social work).	
UNIVFIELD	Dummy variables for each university and field.	

Competition/APPLICANTS	The fraction of first-choice applicants over the number of admitted applicants.
Competition: LOW	A dummy variable taking the value of one if competition is less than two first-choice applicants per study position.
Competition: MEDIUM	A dummy variable taking the value of one if competition is more than two but more than four first-choice applicants per study position.
Competition: HIGH	A dummy variable taking the value of one if competition is more than four first-choice applicants per study position.

Note: The data were collected by Statistics Sweden and consist of several datasets. The variables *parental highest education* and *immigrant background* have been modified to be consistent in the pooled sample.

Table A2: Marginal admission score by university

	Business and Economics		Engineering	
Higher Education Institution	GPA	SweSAT	GPA	SweSAT
Umeå University	15.2	10	10.4	1
Luleå University of technology	14.6	9	9.9	6
Uppsala University	18.7	15	11.2	6
University of Gävle	13.6	7		
Dalarna University	13.4	2		
Mälardalens University	14.6	7	11.2	1
KTH Royal institute of Technology			12.8	11
Örebro University	16.8	11		
Stockholm University				
Linköping University	15.3	10	11.7	5
Jönköping University				
Chalmers University of Technology			15.5	12
University of Gothenburg	17.2	13		
Karlstad University	15.4	9	13	4
University of Skövde	12.8	5		
University of Borås	15.8	11		
Lund University	18.3	13	15.9	12
Halmstad University	15.78	11		
Stockholm School of Economics	19.5	19		
University West	14.32	6		
Blekinge Institute of Technology			11.2	4
Mittuniversitetet	11.9	1	11.7	7
Malmö University				
Ersta Sköndal University College				
University of Gotland (now Uppsala)	12.3	2		
Linnaeus University	15.4	9		

Table A2 cont.

Higher Education Institution	Law		Social work	
	GPA	SweSAT	GPA	SweSAT
Umeå University	18	13	13.8	5
Luleå University of Technology				
Uppsala University	19	15	17.5	11
University of Gävle			12.2	3
Dalarna University			15.2	8
Mälardalens University			15.3	7
KTH				
Örebro University	18.5	13	15.9	8
Stockholm University	18.2	15	15.5	9
Linköping University			16.1	9
Jönköping University			16.2	10
Chalmers University of Technology				
University of Gothenburg	18.5	15	17.1	2
Karlstad University			16	8
University of Skövde				
University of Borås				
Lund University	19.0	15	15.7	8
Halmstad University				
Stockholm School of Economics				
University West				
Blekinge Instititute of Technology				
Mittuniversitetet			14.7	6
Malmö University			15.5	8
Ersta Sköndal University College			16.9	14
University of Gotland (now Uppsala)				
Linnaeus University			15.8	7

Note: The marginal admission score is defined as the smallest GPA or SweSAT student score of all offered programmes within each university and fields of education.

Table A3: Summary statistics by admission group

	Upper Secondary GPA			SweSAT		
Variable	Mean	SD	N	Mean	SD	N
Age	20	1.572	5,379	22	4.193	3,645
Gender (woman)	0.53	0.499	5,379	0.30	0.457	3,645
Foreign background	0.14	0.347	5,379	0.09	0.291	3,645
Parental highest education						
Less than upper secondary schooling	0.02	0.123	5,372	0.03	0.155	3,627
Upper secondary schooling	0.35	0.476	5,372	0.34	0.473	3,627
More than upper secondary schooling	0.64	0.480	5,372	0.64	0.481	3,627

Note: Summary statistics of socioeconomic background by admission group. *Parental highest education* is a categorical variable which indicates the education level of the parent with the highest level of education.

Table A4: Marginal achievement differences; background variables included

	Model 1 (Constant)	Model 2 (Quadratic)	Model 3 (Categorical)
Intercept	-0.030**	-0.076***	
	(0.015)	(0.027)	
Gender (woman)	0.044***	0.045***	0.045***
	(0.007)	(0.007)	(0.007)
Age	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Foreign background	-0.054***	-0.054***	-0.054***
	(0.008)	(0.008)	(0.008)
Parental highest education			
Upper secondary schooling	-0.024	-0.024	-0.024
	(0.015)	(0.015)	(0.015)
More than upper secondary schooling	-0.010	-0.010	-0.010
	(0.015)	(0.015)	(0.015)
Competition		0.030*	
		(0.017)	
Competition squared		-0.003	
		(0.002)	
Competition: LOW			-0.046***
			(0.017)
Competition: MEDIUM			-0.012
			(0.017)
Competition: HIGH			-0.002
			(0.016)
Observations	8,999	8,999	8,999
R-squared	0.177	0.178	0.179

Note: Parameters of the term DIFFG are displayed in the table. Standard errors are clustered at programme level and reported within parentheses. Significance levels are denoted by asterisks, where *** is significant at the 1 per cent level, ** at the 5 per cent level and * at the 10 per cent level. The order of the polynomials $f(\cdot)$ and $h(\cdot)$ is $K = 2$. Field fixed effects and university fixed effects are included in the estimation. The number of observations is 8,999 (full sample) instead of 9,024 because of missing values.

Table A5: Marginal achievement differences; low admission scores excluded

	Model 1 (Constant)	Model 3 (Categorical)		
	Intercept	LOW	MEDIUM	HIGH
A. Full sample				
Pooled data	-0.045**	-0.066***	-0.024	-0.010
(N = 6,390)	(0.018)	(0.021)	(0.020)	(0.019)
Engineering	-0.052**	-	-	-
(N = 4,634)	(0.023)			
Business and Economics	-0.055*	-	-	-
(N = 2,329)	(0.031)			
Social work	0.003	-	-	-
(N = 1,191)	(0.041)			
Law	0.029	-	-	-
(N = 870)	(-0.057)			
B. Restricted sample				
Pooled data	-0.049**	-0.088***	-0.015	0.033
(N = 1,901)	(0.021)	(0.025)	(0.028)	(0.036)
Engineering	-0.074**	-	-	-
(N = 1,369)	(0.029)			
Business and Economics	-0.051	-	-	-
(N = 652)	(0.041)			
Social work	0.055	-	-	-
(N = 331)	(0.075)			
Law	-0.006	-	-	-
(N = 298)	(0.027)			

Note: Parameters of the term DIFFG are displayed in the table. Programmes with GPA < 15 and SweSAT < 10 are excluded. Standard errors are clustered at programme level and reported within parentheses. Significance levels are denoted by asterisks, where *** is significant at the 1 per cent level, ** at the 5 per cent level and * at the 10 per cent level. The order of the polynomials $f(\cdot)$ and $h(\cdot)$ is $K = 2$. Field fixed effects are included in the estimation.

Table A6: Tabulation of competition and field of education

Field of Education	Competition			
	Low	Medium	High	Total
Engineering	3898 (43.2%)	601 (6.7%)	135 (1.5%)	4634 (51.4%)
Business and Economics	1444 (16 %)	391 (4.3%)	494 (5.5%)	2329 (25.8%)
Social work	170 (1.9%)	616 (6.83%)	405 (4.5%)	1191 (13.2%)
Law	0 (0%)	177 (2%)	693 (7.7%)	870 (9.6%)
Total	5512 (61.1%)	1785 (19.8%)	1727 (19.1%)	9024 (100%)

Note: The table reports the number of students in each category of competition. The percentages in the parenthesis show the share of the total sample.