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The Choice of Retaking Competitive Exams

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Abstract

In many countries, access to top science programs is determined by standardized competitive exams. If they fail, candidates are generally allowed to repeat their preparation and retake the exams. Relying on French data, we assess the impact of repetition on repeaters as well as on non-repeaters at the margin of repetition. Both groups appear to benefit equally from repetition, suggesting that students do not self-select into repeating based on their potential progress. Students who choose to repeat are predominantly male and high-income, which contributes to the persistence of significant income and gender gaps in access to top science programs.

JEL codes : I21, I24, I23

Keywords : exam retaking, higher education, gender inequality, socioeconomic inequality, selection into treatment

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1 Introduction

In many societies around the world, access to the best academic institutions is restricted through standardized competitive exams that require extensive preparation. These tests are intended to identify the strongest candidates as objectively as possible.

Success in these exams generally demands considerable preparation and hard work. However, individual performance on the test day can also be influenced by factors that are difficult to control. For instance, students who are lucky enough to come across exam topics or exam questions that match the parts of the syllabus they know best will be at an advantage. By contrast, students who are unlucky enough to be ill on the day of the assessment will be at a disadvantage. As a result, test scores do not always accurately reflect the true potential of each candidate.[1]

To mitigate the role of chance, many educational systems allow candidates to repeat and retake exams after additional preparation. This option is present in a variety of countries, such as France, India, and Japan, where access to prestigious higher education institutions requires performing exceptionally well in highly selective exams. Many candidates only succeed after multiple attempts, suggesting that the opportunity to repeat and retake exams may serve to offset the impact of unfavorable circumstances.

Allowing students to repeat their preparation and retake exams may reduce the influence of chance, but it comes with significant costs—not least because it extends the duration of preparation and delays career entry. More fundamentally, the effectiveness of this opportunity hinges on whether the students who choose to repeat are indeed those with the greatest potential for improvement. Conversely, if the decision to repeat is unrelated to academic potential, it can widen inequalities between groups that differ primarily in their tolerance for a highly stressful preparation process.

To better understand this dynamic, it is important to identify the effects of repeating on both repeaters and non-repeaters, in order to determine whether those who choose to repeat are in fact those for whom the potential benefits of repeating are greatest. However, evaluating this is challenging, primarily because we rarely observe the full extent of progress made by repeaters, and also because it is generally very difficult to infer what the progress of non-repeaters would have been if they had chosen to repeat. In this study, we explore this issue in the context of France's scientific *Grandes Écoles* (hereafter, GE), which are among the most prestigious and selective graduate programs in the country. Using a comprehensive dataset on performance and repetition decisions of undergraduate students preparing for the competitive entrance exams to scientific GE, we are not only able to reconstruct the performance of all repeaters over

[1] See, e.g., Bensnes (2016); Ebenstein, Lavy and Roth (2016); Amanzadeh, Vesal and Ardestani (2020); Garg, Jagnani and Taraz (2020); Park (2022); Gaggero and Tommasi (2023); Landaud, Maurin, Willage and Willén (2024).

the course of their successive participations, but also to assess the effect that repeating would have had on the group of non-repeaters at the margin of indifference between repeating and not repeating, had they decided to repeat.

Our findings show that repeating a year generally leads to improved outcomes. In our context, the vast majority of students who repeat achieve much better results and poorer results in only about 10% of cases. Moreover, by comparing the trajectories of candidates who, in their first attempts, marginally failed to gain admission to a more prestigious program and those who marginally succeeded in gaining admission to that program, we show that students on the margin of indifference between repeating and not repeating would, on average, progress as much as repeaters, and would not be at a greater risk of failure.

Taken together, these results suggest that students do not self-select into repeating based on the gains they could make from doing so. In fact, repeating a year tends to be even more frequent among high-income male students, i.e., among students who are already over-represented in the top rankings at the end of their first attempt. As a result, these students are even more likely to benefit from the gains of repetition than low-income or female students, contributing to the persistence of very significant gaps in access to top programs between gender and income groups. We show that the situation could be very different if year repetitions were reserved for groups less represented in prep schools and top programs. For example, if only low-income students were allowed to repeat a year, the (huge) access gap between high and low-income students in the top 15% or top 25% of competitive exams would be reduced by about a third.

This paper contributes to the literature on the impact of exam retaking and year repetition on educational outcomes (see, e.g., Vigdor and Clotfelter, 2003; Jacob and Lefgren, 2009*a*,*b*; Frisancho, Krishna, Lychagin and Yavas, 2016; Goodman, Gurantz and Smith, 2020; ter Meulen, 2023). Much of this literature has focused on primary or secondary school exams, while our study explores repetition at the higher education level and its implications for admission to selective graduate programs. In addition, our article is also one of the first to compare the distribution of the potential effects of repeating a year for repeaters and non-repeaters of similar initial academic level. By doing so, our paper helps understanding whether those who choose a costly treatment are necessarily those who benefit the most from it, a question long debated in the literature (Heckman and Vytlacil, 2005; Carneiro, Heckman and Vytlacil, 2010; Ketel, Leuven, Oosterbeek and van der Klaauw, 2024).

In the context of undergraduate programs preparing for competitive exams, our analyses suggest that the choice to repeat a year is not driven by the potential gains of repetition. Instead, the group of students who tend to repeat the most is the group best represented at the top of the rankings at the end of the first attempt, namely male students from high-income backgrounds, which contributes to the persistence of inequalities in access to the most prestigious programs between gender and income groups.

Several papers have shown—mostly through lab experiments—that females and low SES students are more likely to turn away from competitive settings than their male or high SES counterparts (see, e.g., Croson and Gneezy, 2009; Niederle and Vesterlund, 2011; Almås, Cappelen, Salvanes, Sørensen and Tungodden, 2016; Landaud, Ly and Maurin, 2020). Recent experimental findings have also shown that women are more likely than men to exit a low stake math competition after a setback (see Buser and Yuan, 2019; Ellison and Swanson, 2021), and tend to leave a TV game contest prematurely (see Hogarth, Karelaia and Trujillo, 2012). Our results are in line with these experimental findings and highlight that one of the mechanisms explaining the over-representation of high-income male students in top graduate scientific programs lies in their greater propensity to repeat and retake exams, combined with the important benefits of repetition and exam retaking for access to the most selective programs.

The article is organized as follows: Section 2 describes the institutional context and section 3 presents the available data. Section 4 develops the conceptual framework within which we will interpret our empirical results. Section 5 and section 6 present the results of our graphical and econometric analyses. Section 7 assesses the contribution of repetition to performance gaps between groups of students defined by gender or parental income. Section 8 concludes.

2 Institutional Setting

Each year, between 20,000 and 25,000 French high school graduates are admitted to a *Classe Préparatoire aux Grandes Écoles Scientifiques* (hereafter, scientific prep schools). These students represent between 10% and 15% of high school graduates with a major in science and less than 3% of a birth cohort. Admission to a prep school is based on high school records. High school students admitted to a prep school are typically among the best students of their senior classes (see, e.g., Bechichi and Bluntz, 2019).

There are about 140 scientific prep schools throughout the country. The vast majority of these schools are public (or heavily subsidized), and the registration fees are almost nil. At the end of two years of preparation, prep students take national competitive exams to obtain admission to one of the GE programs. There are several national competitive examinations (known as *concours*), and each one is organized by a group of GEs. These different national competitions do not take place on the same dates, so that the vast majority of students can generally take part in all the most important ones.

The first year of preparation cannot be repeated and is multidisciplinary, even if a distinction should be made between classes with a Math/Engineering major (about 8,000 students each year), classes with a Physics/Engineering major (about 8,000 students), classes with a Technology/Engineering major (3,000 students) or Biology/Chemistry major (3,000 students). The second year of preparation allows students to further strengthen their specialization. For example, students with a first-year Math/Engineering major can either join a second-year class with a Math major or a second-year class with an Engineering major.

At the end of this second year, students take competitive examinations for the first time. If they are not satisfied with the GE program to which they are admitted after this first attempt, they can repeat a year in order to take the entrance exams a second time (but with the risk of doing less well on their second attempt than on their first). Each year, about 25% of students opt to repeat and retake the exams. After a repetition and a second attempt, however, it is very rare to be allowed to repeat a year a second time (except in the case of health problems).

2.1 Competitive Exams

In this article, our aim is to analyze the distribution of the effects of repetition using administrative information on one of the main competitive examinations, the so-called *Mines-Ponts* competition (hereafter, MP competition).

The MP competition is organized by ten GE programs, including some of the oldest and most prestigious. It attracts about 5,500 applicants with a math major and 3,500 applicants with an engineering major every year, i.e., about 75% of students with such majors. It is also one of the most selective competitive exams: only about 30% of applicants pass the written exams and are allowed to take the oral exams. Eventually, to obtain an offer of admission from one of the five most selective institutions in this competition, one must generally be ranked among the top 15% of applicants. These five programs belong to what is generally regarded as the first-tier group while the five least selective programs in the MP competitions are generally considered second-tier programs.

Approximately 25% of students choose to repeat after their first participation in the MP competition, and of these, almost all retake the MP exams the following year. Our basic research question will be to identify the distribution of the impacts of repetition on final ranking. It should be noted that first-time candidates receive a bonus of points, which corresponds to a gain of about 15 percentile ranks in the overall ranking (as discussed in Appendix B). The bonus is the same for all students. In the remainder of the paper, we will look at the impact of repetition on outcomes adjusted for this bonus of points, and check that our main results are robust to using unadjusted outcomes.

3 Data and Basics Facts

The administrative data used in this paper come from the statistical service of the Ministry of National Education and the statistical service of the MP competition. The data from the MP competition statistical service cover all students registered for this competitive examination with a math or and engineering major, for all sessions between 2012 and 2017. We have information on whether they are taking competitive exams for the first time or the second time (repeaters) as well as on whether they were eligible for the oral examinations (i.e., in the top 30% at the written exams) and, if so, their final ranking.

Data from the Ministry of National Education provide information on all students enrolled in prep schools located in France, for each academic year between 2011–2012 and 2016–2017. These data are anonymous but contain a student identifier that makes it possible to follow students from one academic year to the next. It is possible to distinguish between students enrolled for the first time in the second year of preparation and students repeating their second year of preparation. These data also contain information on students' date of birth, gender, and parental income (as captured by eligibility to means-test financial assistance).

To construct our working sample, we matched the MP data with the Ministry data at the individual level, using student information available in both data sources (i.e., date of birth, prep school attended, major, parental income, first- or second-time participant status, etc.). This matching procedure makes it possible to reconstitute the trajectories of about 94% of first-time participants. The working sample is made up of about 30,000 students who took part in MP competition at the end of their second year of preparation between academic years 2011–2012 and 2015–2016, with information on their results at the end of high school national examinations, the prep schools and classes they attended, their ranking in the MP competition at the end of their first attempt, as well as whether they chose to repeat their second year of preparation. In the latter case, we know whether they retook the MP exams and, if so, their ranking at the end of this second attempt.

Table A1 in the appendix provides some basic statistics describing how the probability of repeating varies by gender, social origin or results at the first attempt. The table confirms that the probability of repeating is very low (about 0.04) for students who finished in the top 15% on their first attempt (which gives access to a tier 1 program). However, it is much higher (about 0.14) for students who finished between the top 15% and the top 25% (which gives access to a tier 2 program), and even higher (about 0.31) for students who did not reach the top 25%. For a given first-attempt result, the repetition rate is lower for women than for men, even though women are largely underrepresented in the top 15% or the top 25%. Also, for a given first-attempt result, the repetition rate is not higher for low-income students than for high-income students, even though here again low-income students are largely underrepresented in the top 15% or the top 25%.

4 Conceptual Framework

We consider a set of students who participate in a competitive exam that gives access to K selective programs (denoted k=1,...,K) listed by ascending order of selectivity and prestige. We denote s_k the percentile rank admission threshold that corresponds to program k, with s_0=0<s_1<...<s_K<s_{K+1}=100. In order for student i to be admitted to program k, his/her percentile rank (denoted $y_{1,i}$) must be greater than s_k. We define k_i^* as the best program to which student i is admitted at the end of his/her first participation.

We assume that student i chooses to repeat a year at the end of his/her first attempt if, and only if, the welfare gain from repeating is greater than the expected cost (denoted c_i). We defined $U_{1,i}(k)$ as the utility for student i to join program k and $U_{2,i}^e$ as the utility s/he expects to achieve a year later if s/he chooses to repeat. Denoting R_i the dummy variable indicating that i chooses to repeat, we have,

$$R_i = 1 \Leftrightarrow U_{2,i}^e > U_{1,i}(k_i^*) + c_i. \tag{1}$$

Finally, for each student i, we define $y_{2,i}$ as his/her final ranking if s/he chooses to repeat a year and β_i=$y_{2,i}$-$y_{1,i}$ as the causal effect of repeating a year on student i's performance. The fundamental inference problem is that we only observe potential outcome $y_{2,i}$ (and parameter of interest β_i) when student i chooses to repeat.

4.1 Marginal Students vs. Non-Marginal Repeaters

In this set-up, for each threshold s_k, we can define marginal students as students who are on the margin of indifference between repeating and not repeating when their initial ranking falls near s_k. Specifically, these students satisfy the following condition,

$$U_{1,i}(k-1) + c_i < U_{2,i}^e < U_{1,i}(k) + c_i \tag{2}$$

which implies that they repeat if their initial percentile rank $y_{1,i}$ falls just below s_k (and $k_i^* = k-1$), but do not repeat if their initial percentile rank falls just above s_k (and $k_i^* = k$). Program k is prestigious enough for them, but not program $k-1$. The increase in the opportunity cost of repetition at the cut-off is enough to make them switch from repeating to not repeating. In the remainder, $V_{k,i} = U^e_{2,i} - (U_{1,i}(k) + c_i)$ will represent student's propensity to repeat a year after admission to school k and $M_{k,i} = \mathbb{1}\left\{V_{k,i} < 0 \; and \; V_{k-1,i} > 0\right\}$ will represent a dummy variable indicating that student i is a marginal student for threshold s_k.

For each threshold s_k, it is also possible to define non-marginal repeaters as students who repeat regardless of whether their initial $y_{1,i}$ falls just above or just below s_k. Program k is not prestigious enough for them, let alone the program $k-1$. Using previous notations, they satisfy ($V_{k,i} > 0$).

Using these definitions, it should be noted that repeaters just above s_k include only non-marginal repeaters (i.e., $V_{k,i} > 0$), while repeaters just below s_k include not only non-marginal repeaters, but also marginal students (i.e., $V_{k,i} < 0 \; and \; V_{k-1,i} > 0$). Consequently, under the assumption that there is no discontinuity at s_k in the distribution of the propensity to repeat $V_{k,i}$, the proportion of marginal students near s_k can be identified by simply comparing the probability of repetition just above and below the threshold. To be more specific, we can write,

$$Pr\left(M_{k,i} = 1 | y_{1,i} = s_k^-\right) = Pr\left(R_i = 1 | y_{1,i} = s_k^-\right) - Pr\left(R_i = 1 | y_{1,i} = s_k^+\right). \tag{3}$$

As we will show in the following sections, there is indeed a significant discontinuity in the probability of repeating at the admission threshold. Assuming that the proportion of students for whom program k is not prestigious enough is similar above and below the threshold, this discontinuity can be interpreted as a measure of the proportion of marginal students.

4.2 Effect of Repetition on Marginal Students

With respect to repeaters, we know the rank $y_{1,i}$ obtained during their first participation as well as the rank $y_{2,i}$ obtained during their second participation. It is therefore not difficult to assess the effect of repetition $\beta_i = y_{2,i} - y_{1,i}$ for repeaters in general and for non-marginal repeaters near threshold s_k in particular. For the latter, all we need to do is measure $(y_{2,i} - y_{1,i})$ for repeaters whose results fell just above s_k at the end of the first participation.

For marginal students, on the other hand, we still know $y_{1,i}$, but we only know $y_{2,i}$ when they choose to repeat, meaning we simply observe their initial result $y_{1,i}$ and their final result $y_i = y_{1,i} + R_i\beta_i$ (which is $y_{1,i}$ if they choose not to repeat and $y_{2,i}$ if they choose to repeat).

For these students, it is not possible to have a direct measure of $\beta_i = y_{2,i} - y_{1,i}$, but it is possible to measure $\Delta y_i = y_i - y_{1,i} = R_i\beta_i$, namely the difference between their final and initial results. The key point is that, under the assumption that there is no discontinuity in the joint distribution of β_i and $V_{k,i}$ at the threshold, we can identify the distribution of β_i for marginal students by simply comparing the distribution of Δy_i above and below these admission thresholds. To understand why this is the case, let us consider, for example, a possible positive value b for β_i and let us focus on students whose initial result $y_{1,i}$ falls just above s_k (i.e., $y_{1,i} = s_k^+$). For this type of student, $\Delta y_i > b$ means both that they are repeaters (otherwise $\Delta y_i = 0$) and that $\beta_i > b$. As repeaters whose result falls just above s_k, they are even non-marginal repeaters (i.e., $V_{k,i} > 0$). In other words, we have,

$$Pr\left(\Delta y_i > b | y_{1,i} = s_k^+\right) = Pr\left(\beta_i > b \ and \ V_{k,i} > 0 | y_{1,i} = s_k^+\right) \tag{4}$$

If we now consider students whose initial $y_{1,i}$ falls just below s_k (i.e., $y_{1,i} = s_k^-$), the condition $\Delta y_i > b$ again means that they are repeaters and that $\beta_i > b$. Only, in their case, the fact that they are repeaters can mean either that they are non-marginal repeaters or that they are marginal students and we can write,

$$Pr\left(\Delta y_i > b | y_{1,i} = s_k^-\right) = Pr\left(\beta_i > b \ and \ V_{k,i} > 0 | y_{1,i} = s_k^-\right) + Pr\left(\beta_i > b \ and \ M_{k,i} = 1 | y_{1,i} = s_k^-\right). \tag{5}$$

Hence, under the assumption that the joint distribution of β_i and $V_{k,i}$ is continuous at the admission threshold, $Pr\left(\beta_i > b \ and \ V_{k,i} > 0 | y_{1,i}\right)$ is similar above and below the threshold and the difference between $Pr\left(\Delta y_i > b | y_{1,i} = s_k^+\right)$ and $Pr\left(\Delta y_i > b | y_{1,i} = s_k^-\right)$ identifies the proportion of students who are both marginal and satisfy $\beta_i > b$. Dividing this proportion by the proportion of marginal students given by equation (4), we can also write,

$$Pr\left(\beta_i > b | y_{1,i} = s_k \ and \ M_{k,i} = 1\right) = \frac{Pr\left(\Delta y_i > b | y_{1,i} = s_k^-\right) - Pr\left(\Delta y_i > b | y_{1,i} = s_k^+\right)}{Pr\left(R_i = 1 | y_{1,i} = s_k^-\right) - Pr\left(R_i = 1 | y_{1,i} = s_k^+\right)} \tag{6}$$

In our set-up, the probability that β_i exceeds a given value b conditionally on respondent i being at the margin between repetition and non-repetition simply corresponds to the ratio between the discontinuity in the probability that Δy_i exceeds b and the discontinuity in the probability of repeating a year at the admission threshold. The probability can therefore be evaluated in a very standard way as the regression discontinuity (RD) estimate of the effect of repetition on the probability of observing ($\Delta y_i > b$). As discussed above, the identifying assumption is simply that the values taken by admission thresholds at the end of the exams do not fall on points of discontinuity in the proportion of students for whom program

k is not prestigious enough and whose potential for progress is greater than b.

5 Graphical Results

In this section, we draw on our conceptual framework to give a first graphical assessment of the effect that repeating a year would have on the performance of students who are on the margin of indifference between repeating and not repeating at the end of their first attempt.

To begin with, Figure 1 considers the sample of first-time participants who are eligible for admission to at least one program,[2] and compares the probability of repeating for students on either side of admission thresholds. The figure confirms that this probability is significantly lower for students just above admission thresholds. More precisely, it averages about 0.12 for students just below the thresholds and 0.10 for those just above. For the latter, repeating a year means foregoing admission to a more prestigious GE program, and this increase in the opportunity cost of repeating is enough to reduce the proportion of repeaters by two percentage points (or -17%). In our conceptual framework, we can estimate at 2% the proportion of first-time participants who are on the margin of repeating and such that a marginal variation in their results would be enough to tip them either into repeating or not repeating.

Repeating a year can lead to an improvement in results, but it can also lead to stagnation or even decline. To give an initial measure of the effect of repetition on marginal students, Figure 2 considers the probability of obtaining a better result in the last participation in the competition than in the first (i.e., with the notations of the previous section, the probability of observing $\Delta y_i > 0$), and compares the value of this probability above and below the admission threshold. The figure shows that this probability decreases by about 2 percentage points at the cut-off, almost exactly the same decrease as the probability of repeating a year in Figure 1. Specifically, it averages 0.11 for students just below the thresholds and 0.09 for those just above.

Assuming that there is no discontinuity in the joint distribution of students' propensity to repeat and potential outcomes at the cutoff points, the decline in the probability of observing $\Delta y_i > 0$ in Figure 2 captures the proportion of marginal students for whom the effect of repetition β_i is positive. Hence, the comparison of Figure 1 and Figure 2 is suggestive that almost all marginal students are students for whom repeating a year would lead to a better final ranking.

On the other hand, when we focus on students just above the cut-off and compare the proportion of repeaters in Figure 1 (around 0.10) with the proportion of repeaters whose final ranking is higher

[2]Our working sample excludes students who are located around the admission threshold of the least selective program, as very few students obtain a ranking below the admission threshold of this program.

than their initial ranking in Figure 2 (around 0.09), we find that repeating a year results in improved performance for about 90% of non-marginal repeaters, i.e., a largely positive impact of repeating a year for non-marginal repeaters, albeit a little lower than the estimated impact for marginal students. This is a first indication that those who choose to repeat are not necessarily those for whom the impact of repeating is strongest.

In online Appendix A, we provide additional figures showing that there is no significant discontinuity in students' baseline characteristics (gender, social background, high school exam scores) at the cutoff (see Figures A1a–A1c in Appendix A). This is consistent with our identifying assumption that there is no discontinuity in students' expectations or potential outcomes at the cutoff.

6 Regression Analysis

To test the robustness of our graphical results and provide a more comprehensive picture of the potential effects of repetition, this section develops a regression discontinuity (RD) analysis of the impact of repetition on students' final test rankings using first-attempt ranking $y_{1,i}$ as the forcing variable and admission thresholds s_k as the source of identification.

Specifically, we keep on focusing on students whose first-attempt ranking $y_{1,i}$ falls just above or below an admission threshold,[3] and we estimate the following RD model:

$$Y_i = \alpha \mathbb{1}\left\{y_{1,i} - s_k \geq 0\right\} + \beta\left(y_{1,i} - s_k\right) + \gamma\left(y_{1,i} - s_k\right) \times \mathbb{1}\left\{y_{1,i} - s_k \geq 0\right\} + X_i\theta + u_i \tag{7}$$

where Y_i represents the outcome of student i, while $y_{1,i}$ denote his/her first-attempt ranking. Variable X_i is a set of control variables (including year dummies, major dummies, and school dummies as well as student's age, gender, low-income status, and high school graduation results). Variable u_i represents unobserved residuals which distribution is assumed to be continuous at the cut-off point. Table A2 in the Online Appendix reports the results of regressing students' predetermined individual characteristics (gender, low-income status, age, and high school graduation results) on a dummy indicating falling just above an admission threshold using the same RD model. Consistent with our identifying assumption, we do not find evidence of systematic discontinuous variations in baseline characteristics at the eligibility cutoff.[4] We rely on a double-lasso procedure to define the subset of controls that are actually included in

[3] Similarly to the graphical analysis, our working sample excludes students who are located around the admission threshold of the least selective program, as very few students obtain a ranking below the admission threshold of this program.

[4] We also build on McCrary (2008) to test for possible manipulation of the running variable around the cutoff. Figure A3 does not show any significant difference in the (log) height at the cutoff.

each regression.

The parameter of interest is α. It provides a measure of the outcome discontinuity at the cut-off point. Following Pop-Eleches and Urquiola (2013), we estimate α after stacking the observations below and above the different admission thresholds, so that every student can be used as an observation for every admission threshold, and we cluster standard errors at the student level. We follow Calonico, Cattaneo and Titiunik (2014) to define an optimal bandwidth around the cutoff points (this optimal bandwidth is of about 17 percentile ranks), and we use a triangular kernel centered around admission cutoffs. In Appendix A, we show that our results are robust to alternative functional forms, bandwidths, and sets of control variables.

The first-stage and reduced-form results are shown in the Panel A of Table 1. The first column shows the first stage result, i.e., the estimated discontinuity in repetition rate at the cut-off point. The following columns show the reduced-form results for a comprehensive set of five outcomes. Specifically, they show the estimated alpha for outcome variables indicating in turn whether the difference Δy_i between final and initial ranking is (1) positive and greater than 20 percentile ranks ($\Delta y_i > 20\ pc$), (2) positive and greater than 10 percentile ranks ($\Delta y_i > 10\ pc$), (3) positive ($\Delta y_i > 0$), (4) negative and of at least -10 percentile ranks ($\Delta y_i < -10\ pc$), (5) negative and of at least -20 percentile ranks (i.e., $\Delta y_i < -20\ pc$). A gap of 10 percentile rank corresponds to the average gap between two admission thresholds.

The different models in Table 1 are all estimated on the same sample, i.e., the sample of students whose first-attempt results are neither in the bottom 20% nor in the top 20%, so that the six outcomes studied are all well-defined for each of the students in the sample and are not constrained to take the value 0 or 1 for any of them.[5]

In line with Figure 1, the first column of Panel A confirms that repeating is significantly less frequent for students whose first-attempt rankings fall just above the admission thresholds than for those just below (-1.9 percentage points). The following columns further show that this drop in the proportion of repeaters at the cut-off point is accompanied by a parallel drop in the proportion of students whose final ranking is 20 percentile ranks higher than their initial ranking. By contrast, no change is detected at the cut-off point in the proportion of students whose final ranking is lower than their initial ranking. These reduced-form results suggest that almost all students who are on the margin of indifference between repeating and not repeating (our compliers) are students who would progress by more than 20 percentile ranks in the rankings if they decided to repeat.

[5] Table A3 in the online appendix shows that similar results are obtained when each outcome is analyzed on the specific maximum sample on which each outcome is well defined.

Panel B of Table 1 provides the corresponding IV estimates of the impact of repetition, i.e., the estimated effects of repetition when we use $Z_i = \mathbb{1}\left\{y_{1,i} - s_k > 0\right\}$ as instrumental variable. Consistent with our reduced-form analysis, these IV estimates suggest that the final ranking of compliers would be improved by 20 percentile ranks with a probability of about 1 if they decided to repeat.

Finally, Panel C of Table 1 shows the OLS estimates of repetition on non-marginal repeaters, namely repeaters whose ranking fell just above an admission cutoff.[6] These OLS estimates suggest that repetition is followed by an improvement of more than 20 percentile ranks for almost 80% of these repeaters, and a drop in ranking for just about 10% of them. The impact of repeating a year on these repeaters is therefore largely positive, but not as positive as that on students on the margin of repeating a year. The comparison of Panel B and Panel C confirms that the impact of repeating a year is not necessarily greater for students with the highest propensity of choosing to repeat a year.

Table A4 in the appendix replicates Table 1 using the unadjusted scores as a measure of performance (i.e., scores unadjusted for the bonus points awarded to first-time applicants). The diagnosis obtained is similar to that of Table 1, with in particular an estimated probability of failure of almost zero for marginal non-repeaters and of about 0.10 for non-marginal repeaters.[7]

Finally, using the same RD model as in Table 1, Table A6 first confirms that the probability of finishing ranked at the last participation (i.e., in the top 30%) is not different for first-time participants who finish ranked just above or just below an admission threshold. This result is consistent with our finding that the impact of repeating on the probability of falling in the ranking is almost zero. Focusing on students who finish ranked at both their first and last participation, Table A6 also provides an RD estimate of the impact of repeating on the average ranking of marginal non-repeaters. The estimated impact is 33 pc, which is not significantly different from that observed on average among repeaters (38 pc). Column 4 of Table A6 confirms that this result holds when we use rankings unadjusted for the bonus of points granted to first-time participants.

7 Contribution of Repetitions to Access Gaps

In the previous sections, we showed that choosing to repeat a prep school year is generally followed by very significant academic gains. We also found that, for a given first-attempt result, the choice of repeating a year is not more frequent for female students or low-income students, even though these students are largely under-represented at the top of rankings. Given these facts, it is doubtful that repeating a year

[6]In practice, we focus on repeaters whose first-attempt ranking falls between the cutoff itself and 5 percentiles above.
[7]Figure A4 and Table A5 also show that our results are robust to alternative specifications for the RD model.

really helps to reduce inequalities between groups of students defined by gender or social origin. We might even wonder whether we could not increase the representation of women and low-income students by restricting the possibility of repeating a year.

To shed light on these questions, we reconstructed for each group of students defined by gender or parental income the proportion who would have finished among the top 15% (or the top 25%) of their cohort if only the results of the first participation in the exams had been considered and we compared this theoretical proportion with the proportion actually observed, as well with the proportion that would have been observed if only low-income students had been allowed to repeat a year, and with the proportion that would have been observed if only girls and low-income students had repeated a year.

The results are shown in Table 2. If only the results of the first attempt had been taken into account, the table shows that the proportion of students who would have reached the top 15% would have been more than twice as low for low-income students (8.1%) as for high-income students (18.4%), i.e., a gap of about 10.3 percentage points. This (huge) theoretical gap is in fact almost exactly the one that is actually observed (i.e., 10.0 percentage points). In other words, as it is distributed in the student population, repeating a grade greatly improves the performance of the students concerned, but has almost no impact on the ranking gap between low-income and high-income students. The situation would be very different if only low-income students were allowed to repeat a grade: in this case, the table shows that the gap in access to the top 15% between low-income and high-income students would be reduced by about 35% (and would amount to only 6.7 percentage points).

Regarding the gender gap itself, the table shows that the proportion of students reaching the top 15% would be approximately 2.9 percentage points lower for female students (12.7%) than for male students (15.6%) if only the results obtained at the first participation were taken into account, i.e., a gender gap of approximately 20%. This gap is significant, but it is in fact rather smaller than the gap of 3.4 percentage points that is actually observed, once all year repetitions are taken into account. Since year repetitions are more frequent for male students, they tend to increase the gender gap. The results would not be much different if only low-income students were allowed to repeat, but they would be very different if female students were also allowed to repeat (i.e., if only high-income males did not repeat). In this case, the gender gap in access to the top 15% would be almost reduced to zero.

The second panel in Table 2 replicates the analysis of the first one, focusing on access to the top 25%. The diagnosis is similar: repetition has almost no effect on the (very strong) inequalities in access to the top 25% between low-income and high-income students (or between male and female students), whereas it would have a very significant effect if it were reserved for low-income students only (or to girls and low-income students only).[8]

Overall, this analysis suggests that the access gaps to the most selective programs could be strongly reduced by restricting the possibility of repeating a year, for example by restricting it as much as possible to low-income students.

8 Conclusion

In many countries, access to the most prestigious higher education programs requires passing long, difficult-to-prepare exams, which may have to be retaken several times.

Drawing on particularly rich French data, we show that the choice of repeating a year is not the prerogative of students with the greatest margins for progress. For a given level of initial performance, students who choose to repeat a year have an even higher risk of failure than those who remain on the margin of repeating.

In fact, the students least put off by an extra year of preparation are recruited above all from among high-income male students, i.e., from the socio-demographic group already most strongly represented at the top of the rankings, which contributes to the persistence of major inequalities in access to the most prestigious programs between gender and income groups. The gap in access to elite programs between low-income and high-income students is considerable, but it would be reduced by more than a third if repetitions were reserved for the poorest students.

[8]Table A7 further shows that we reach similar conclusions when we consider standardized rankings that are not adjusted for the bonus of points granted to first-time applicants.

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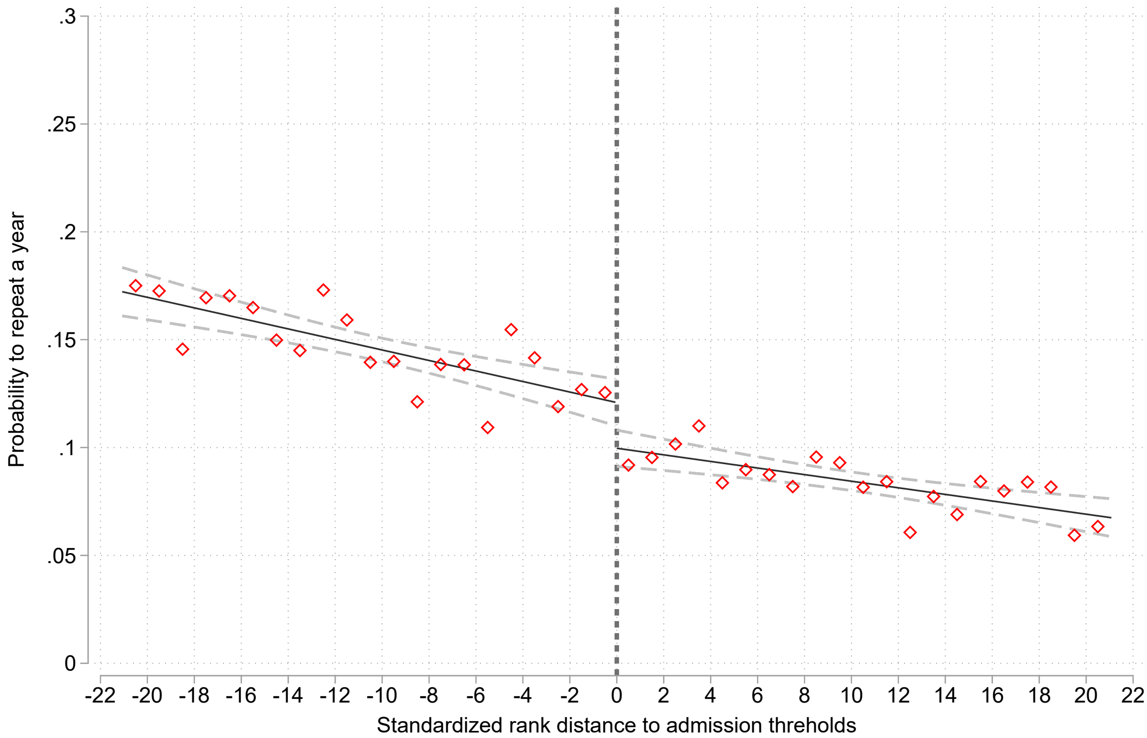


Figure 1: Distance to Threshold and Probability of Repeating a Year

Notes: The figure refers to the sample of students who for the first-time entered the MP competition between 2012 and 2016 (math and engineering tracks). We focus on those whose standardized score at their first attempt fell either just below or just above the admission threshold of a MP program, and we show the proportion who chose to repeat a year, plotted against the standardized distance to the threshold. The bandwidth is computed following Sebastian Calonico, Matias D. Cattaneo and Rocio Titiunik (2014).
Reading: The proportion of first-time participants who chose to repeat a year is about 12% just below the threshold, and 10% just above.

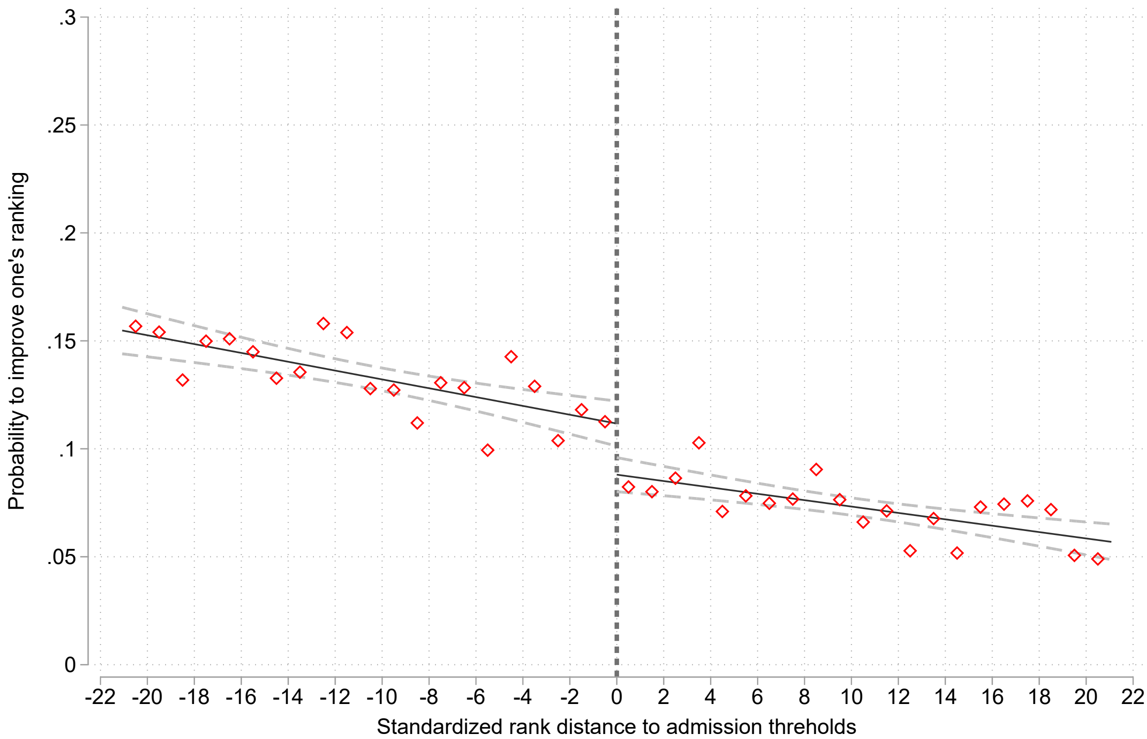


Figure 2: Distance to Threshold and Joint Probability of Repeating a Year and Improving One's Ranking

Notes: Same RD sample as Figure 1. The figure shows the proportion of students who managed to improve their initial ranking, that is, who repeated a year and obtained a strictly better standardized ranking at their second attempt (plotted against the initial standardized distance to the threshold). Standardized rankings are adjusted for first-time bonuses.
Reading: The proportion of first-time participants who repeated a year and obtained a better ranking at their second attempt is about 11% just below the threshold and 9% just above.

Table 1: Repetition Decisions and Gains in Student Achievement

	Repetition	Ranking gain > 20 pc.	Ranking gain > 10 pc.	Ranking gain > 0	Ranking loss > 10 pc.	Ranking loss > 20 pc.
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Reduced form estimates						
Above	-0.019**	-0.020**	-0.019**	-0.020**	-0.001	-0.000
	(0.010)	(0.009)	(0.009)	(0.009)	(0.003)	(0.003)
Mean at the thresholds	.13	.102	.112	.116	.0112	.0102
N	20483	20483	20483	20483	20483	20483
Panel B: IV estimates		0.931***	0.938***	0.946***	0.048	0.021
		(0.233)	(0.187)	(0.166)	(0.143)	(0.144)
N		20483	20483	20483	20483	20483
Panel B: Non-marginal repeaters		0.769***	0.840***	0.872***	0.110***	0.107***
		(0.023)	(0.020)	(0.018)	(0.017)	(0.017)
N		337	337	337	337	337

Notes: Panel A and B refers to the sample of students who for the first-time entered the MP competition (math and engineering tracks) between 2012 and 2016, and whose first-participation results were neither in the bottom 20% nor in the top 20%. Panel C is further restricted to repeaters whose standardized ranking on their first attempt fell just above an admission cutoff point (i.e., between a cutoff and 5 percentiles above).

Each column corresponds to a specific dependent variable, namely a dummy indicating year repetition (column 1), a dummy indicating whether the difference between final and initial ranking is positive and greater than 20 percentile ranks (column 2), positive and greater than 10 percentile ranks (column 3), positive (column 4), negative and of at least -10 percentile ranks (column 5), negative and at least -20 percentile ranks (column 6). Standardized rankings are adjusted for the bonus of points granted to first-time participants.

For each dependent variable, Panel A shows the estimated impact of falling just above the admission threshold, while Panel B provides the corresponding IV estimates of the impact of repetition, i.e., the estimated effects of repetition when we use falling just above the admission threshold as instrumental variable.

Standard errors clustered at the individual level are given in parenthesis. Each cell corresponds to a specific regression. All regressions include controls selected by double-lasso among student's preparatory school, type of class attended, age, gender, low-income status, and high school graduation results; as well as a triangular kernel centered around admission cutoffs; a full set of GE program#major#year dummies; and a first-order spline function of the running variable with cutoff-specific trends. The bandwidth is computed following Sebastian Calonico, Matias D. Cattaneo and Rocio Titiunik (2014).

In addition, Panel C reports the mean of each dependent variable for the sample of repeaters whose initial standardized ranking fell just above an admission cutoff point (i.e., between the cutoff and 5 percentiles above).

* significant at 10%. ** significant at 5%. *** significant at 1%.

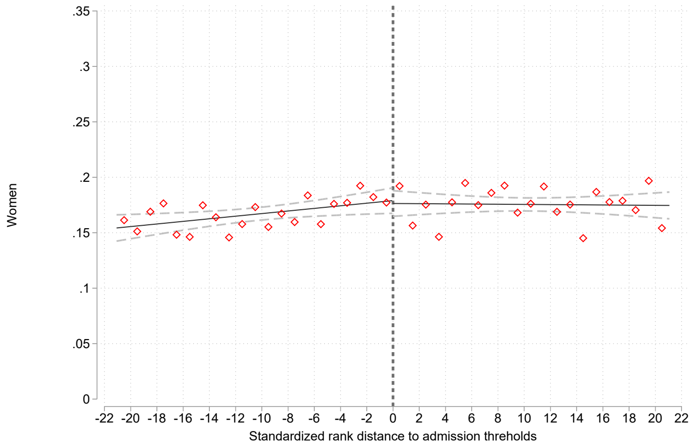
Table 2: Repetition Decisions and Achievement Gaps in Elite Science Competitions

	Women (1)	Men (2)	Gender gap (2) - (1)	Low-income students (3)	High-income students (4)	Income gap (4) - (3)
Top 15% at first attempt	0.127	0.156	-0.029	0.081	0.184	-0.103
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 15% with repetition for low-income students	0.126	0.156	-0.031	0.105	0.172	-0.067
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 15% with repetition for women and low-income students	0.145	0.151	-0.006	0.101	0.174	-0.072
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 15% at last participation	0.123	0.157	-0.034	0.083	0.183	-0.100
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 25% at first attempt	0.210	0.261	-0.051	0.149	0.300	-0.150
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Top 25% with repetition for low-income students	0.209	0.261	-0.052	0.178	0.286	-0.108
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Top 25% with repetition for women and low-income students	0.236	0.254	-0.018	0.173	0.288	-0.116
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Top 25% at last participation	0.205	0.262	-0.058	0.148	0.300	-0.152
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Observations	6214	22992	29206	9673	19533	29206

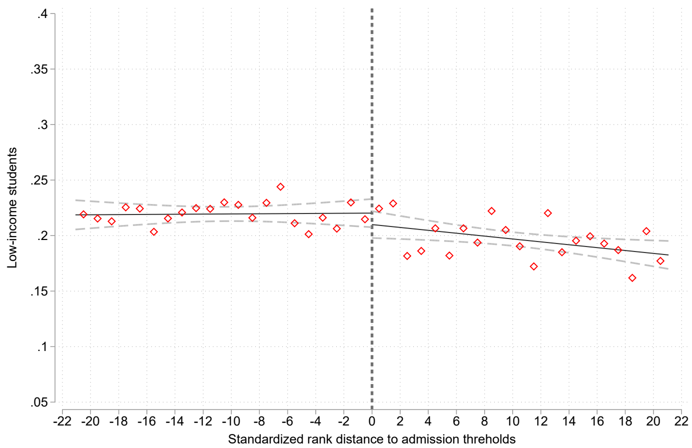
Notes: The table refers to the sample of students who for the first-time entered the MP competition between 2012 and 2016 (math or engineering track).
Column 1 refers to the subsample of female applicants, column 2 refers to the subsample of male applicants, column 3 refers to the subsample of students eligible for means-tested financial assistance, and column 4 refers to the subsample of students non-eligible for means-tested financial assistance.
For each subsample of applicants, the first row shows the proportion of students initially ranked among the top 15% of their cohort, as well as the gender and income gaps in access to this top 15%. Row 2 shows similar results if only low-income students were allowed to repeat (i.e., considering final rankings for low-income applicants and first-attempt rankings for other applicants). Row 3 shows similar results if only low-income students and women were allowed to repeat (i.e., considering final rankings for low-income applicants and women and first-attempt rankings for other applicants). Lastly, row 4 shows the actual observed access and access gaps to the top 15%.
Rows 4 to 8 present a similar analysis as the first panel, considering access and access gaps to the top 25%.
Standardized rankings are adjusted for the bonus of points granted to first-time participants.
Standard errors are in parenthesis.

Appendix A

(a)



(b)



(c)

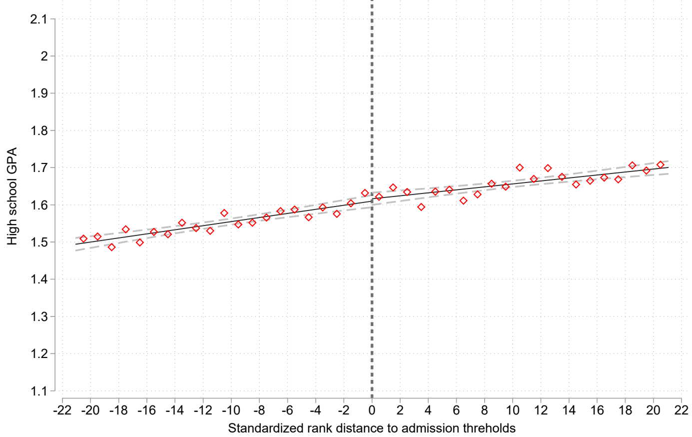


Figure A1: Distance to Threshold and Students' Baseline Characteristics

Notes: Same RD sample as Figure 1. The figure shows students' baseline characteristics, plotted against the standardized distance to the threshold.

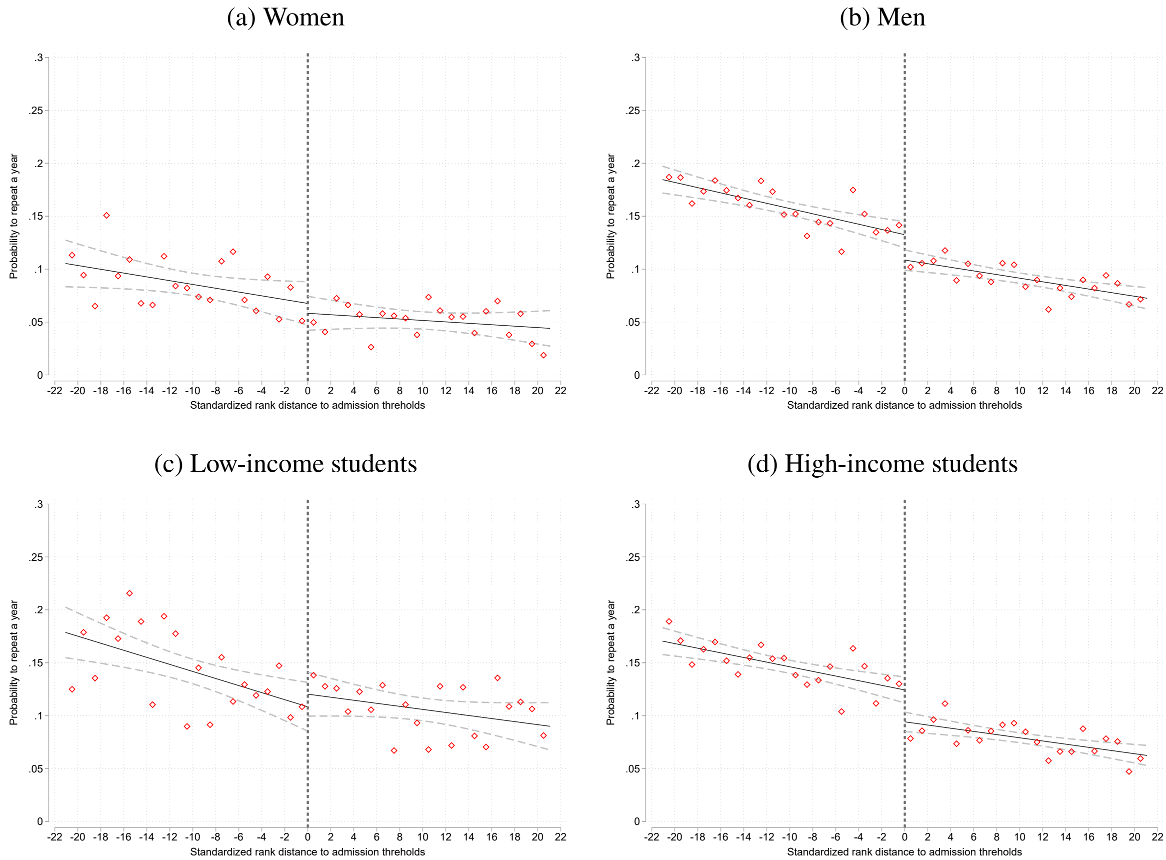


Figure A2: Distance to Thresholds and Probability of Repeating a Year by Gender and Low-Income Status

Notes: Same RD sample as Figure 1. The figure shows similar results as Figure 1 for four subsamples of applicants: female applicants (a), male applicants (b), students eligible for means-tested financial assistance (c), and students non-eligible for means-tested financial assistance (d).

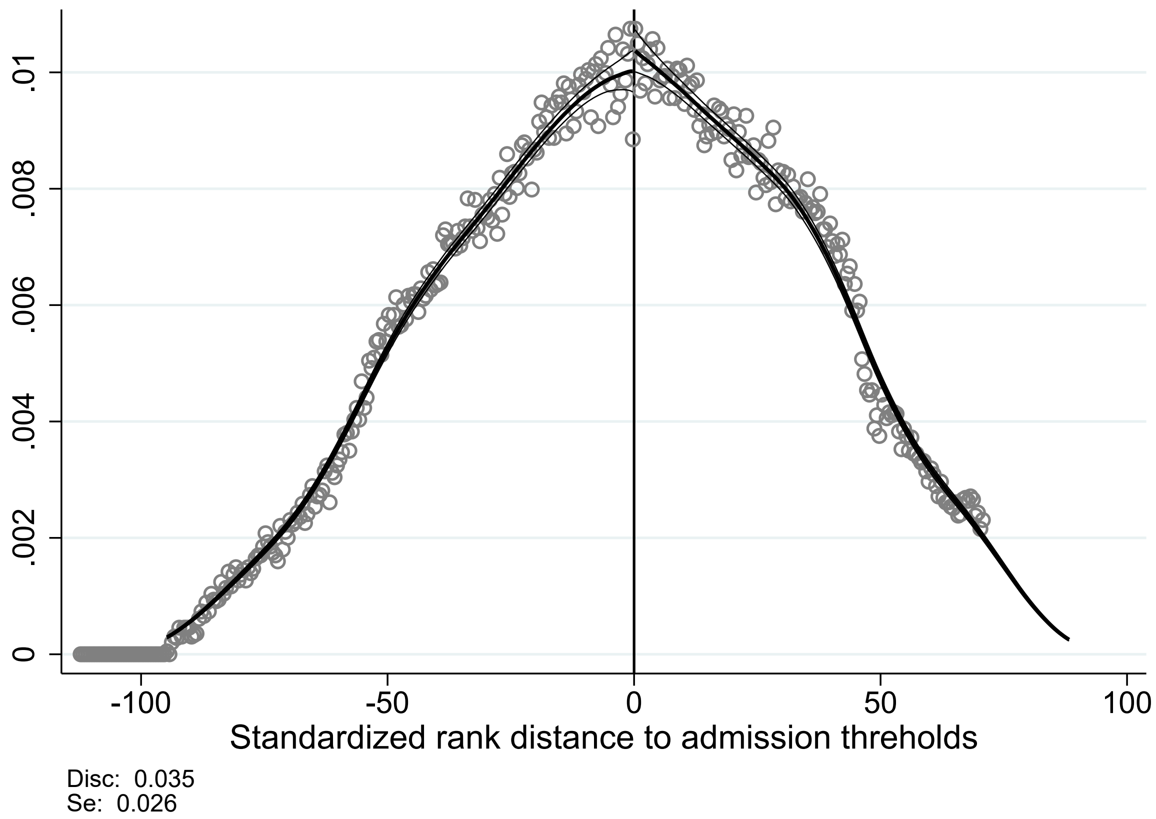
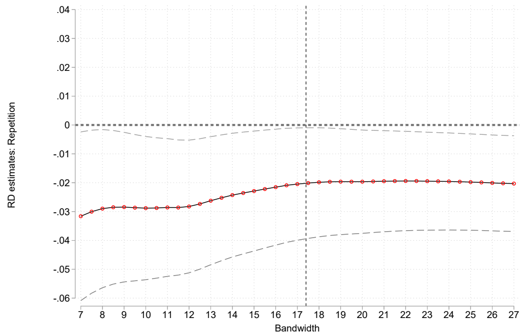


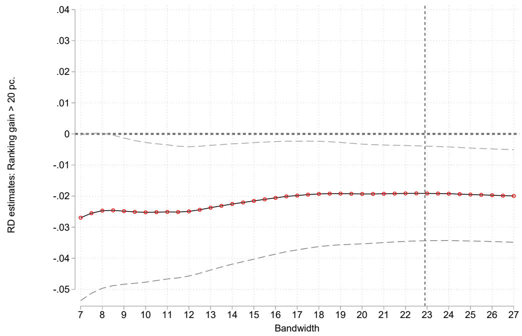
Figure A3: Density of Observations around Admission Cutoffs

Notes: The figure refers to the sample of students who for the first-time entered the MP competition between 2012 and 2016 (math or engineering tracks). The figure presents nonparametric estimates of the density of observations on either side of the admission thresholds following McCrary (2008). Each circle shows the average frequency of students per bin of the running variable. The solid lines represent estimated density functions, and the dashed lines represent the corresponding 95% confidence intervals. The bottom left of the figure reports the estimated discontinuity for the density at the cutoff with its standard errors.

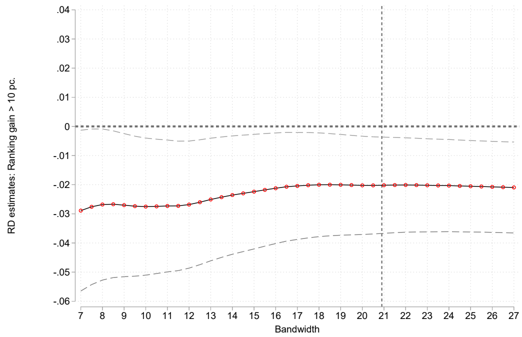
(a) Probability of Repeating a Year



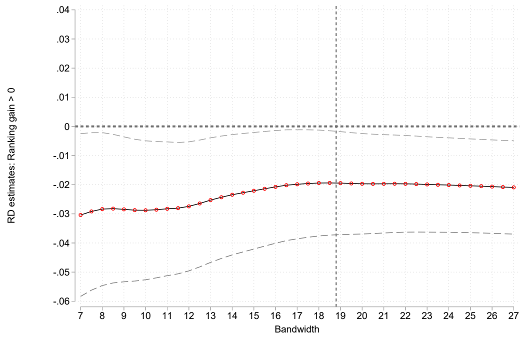
(b) Ranking Gain > 20 pc.



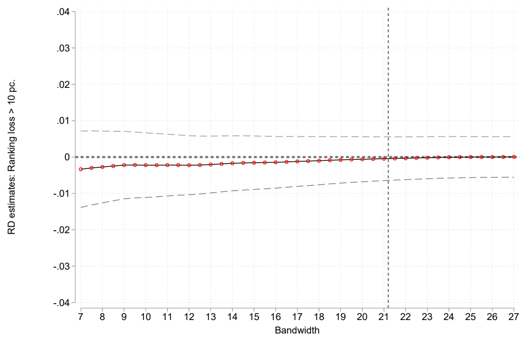
(c) Ranking Gain > 10 pc.



(d) Ranking Gain > 0



(e) Ranking Loss > 20 pc.



(f) Ranking Loss > 20 pc.

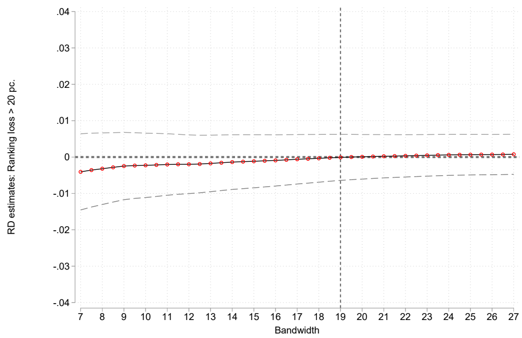


Figure A4: Robustness to Bandwidth Selection

Notes: The figure refers to the sample of students who for the first-time entered the MP competition between 2012 and 2016 (math and engineering tracks), and whose first-participation results were neither in the bottom 20% nor in the top 20% (i.e., same sample as Table 1). The figure reports the estimated effect of falling just above the admission threshold of a MP program on six different outcomes with varying bandwidths. The six outcomes considered are the same as in Table 1. The solid red line represents the point estimates from a linear specification with triangular weights using the same specification and control variables as in Table 1. The vertical line shows the optimal bandwidth. The dashed lines represent 95% confidence intervals (standard errors are clustered at the individual level).

Table A1: Result at First Participation and Repetition Decisions by Gender and Income Groups

	Top 15% (1)	Top 15% - Top 25% (2)	Bottom 75% (3)
Repetition decision: all	0.043	0.142	0.311
	(0.003)	(0.006)	(0.003)
N	4377	2920	21909
Repetition decision: men	0.047	0.152	0.326
	(0.004)	(0.007)	(0.004)
N	3588	2404	17000
Repetition decision: women	0.025	0.097	0.257
	(0.006)	(0.013)	(0.006)
N	789	516	4909
Repetition decision: high-income students	0.043	0.139	0.315
	(0.003)	(0.007)	(0.004)
N	3591	2262	13680
Repetition decision: low-income students	0.047	0.152	0.303
	(0.008)	(0.014)	(0.005)
N	786	658	8229

Notes: The table refers to the sample of students who for the first-time entered the MP competition between 2012 and 2016 (math or engineering track). Column 1 refers to the subsample of applicants who scored among the top 15% of their cohort at first participation, column 2 refers to those who scored lower than the top 15% but higher than the bottom 75%, column 3 refers to applicants in the bottom 75%. For each subsample, the first panel shows the proportion of students who decided to repeat. The second panel shows similar results by gender, and the third panel shows results depending on whether students are eligible to means-tested financial assistance. Standard errors are in parenthesis.

Table A2: Balancing Tests

	Women	Low-income students	Age < 20	HS graduation with honors	High school GPA	High school Math GPA	Parisian prep. school	Star class
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Above	-0.006	-0.002	-0.011	-0.002	-0.006	0.010	-0.011	-0.004
	(0.010)	(0.010)	(0.012)	(0.007)	(0.009)	(0.008)	(0.012)	(0.010)
Mean at the thresholds	.181	.214	.324	.838	1.59	1.56	.319	.765
Observations	26724	26724	26724	26724	26724	26724	26724	26724

Notes: The table refers to the sample of students who for the first-time entered the MP competition between 2012 and 2016 (math and engineering tracks). Each column corresponds to a specific dependent variable. Columns 1–3 describe students' baseline demographic characteristics, that is, whether they are female students (column 1), whether they are eligible for means-tested financial assistance (column 2), and whether they are younger than 20 years when first entering the MP competition. Columns 4–6 correspond to variables describing students' baseline academic level at the end of high school, namely whether they graduated with honors (column 4), their standardized average mark for all subjects as assessed at the national exams for high school graduation (column 5), and their standardized average mark in Mathematics at the national exam for high school graduation (column 6). Columns 7 and 8 describe the type of preparatory school and class in which students are enrolled, that is, whether they are enrolled in a preparatory school located in Paris (column 7), and whether they attended a high ability ("star") class (column 8). For each dependent variable, the table shows the impact of falling just above the admission threshold. Standard errors clustered at the individual level are given in parenthesis. All regressions include the same control variables and use the same specification as in Table 1.

* significant at 10%. ** significant at 5%. *** significant at 1%.

Table A3: Repetition Decisions and Gains in Student Achievement

	Repetition	Ranking gain > 20 pc.	Ranking gain > 10 pc.	Ranking gain > 0	Ranking loss > 10 pc.	Ranking loss > 20 pc.
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Reduced form estimates						
Above	-0.017**	-0.019**	-0.018**	-0.017**	-0.000	-0.001
	(0.008)	(0.009)	(0.008)	(0.007)	(0.003)	(0.003)
Mean at the thresholds	.133	.12	.118	.121	.0103	.00955
N	26724	23301	25198	26724	25667	23906
Panel B: IV estimates		1.068***	1.055***	1.029***	0.026	0.067
		(0.303)	(0.249)	(0.192)	(0.153)	(0.121)
N		23301	25198	26724	25667	23906
Panel B: Non-marginal repeaters		0.779***	0.835***	0.877***	0.108***	0.105***
		(0.021)	(0.019)	(0.017)	(0.016)	(0.017)
N		384	388	389	388	342

Notes: The table reports the main results of Table 1 using alternative samples, namely the maximum samples on which each outcome is well defined.
* significant at 10%. ** significant at 5%. *** significant at 1%.

Table A4: Repetition Decisions and Gains in Student Achievement

	Repetition	Ranking gain > 20 pc.	Ranking gain > 10 pc.	Ranking gain > 0	Ranking loss > 10 pc.	Ranking loss > 20 pc.
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Reduced form estimates						
Above	-0.018*	-0.007	-0.015*	-0.020**	-0.001	-0.001
	(0.010)	(0.007)	(0.008)	(0.009)	(0.004)	(0.004)
Mean at the thresholds	.141	.0784	.0986	.114	.0162	.0128
N	20536	20536	20536	20536	20536	20536
Panel B: IV estimates		0.376	0.741***	1.006***	0.061	0.056
		(0.268)	(0.259)	(0.262)	(0.179)	(0.157)
N		20536	20536	20536	20536	20536
Panel B: Non-marginal repeaters		0.547***	0.674***	0.787***	0.135***	0.116***
		(0.026)	(0.025)	(0.022)	(0.018)	(0.017)
N		362	362	362	362	362

Notes: The table reports the main results of Table 1 using standardized rankings that are not adjusted for the bonus of points granted to first-time participants. * significant at 10%. ** significant at 5%. *** significant at 1%.

Table A5: Robustness to the Choice of Control Variables and Functional Forms

	Repetition		Ranking gain > 20 pc.		Ranking gain > 10 pc.		Ranking gain > 0		Ranking loss > 10 pc.		Ranking loss > 20 pc.	
Panel A: Robustness to control variables												
	No controls	All controls	No controls	All controls	No controls	All controls	No controls	All controls	No controls	All controls	No controls	All controls
Above	-0.023**	-0.020**	-0.021**	-0.018**	-0.021**	-0.018**	-0.022**	-0.018**	-0.001	-0.001	-0.000	-0.001
	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	20483	20483	20483	20483	20483	20483	20483	20483	20483	20483	20483	20483
Panel B: Robustness to functional forms												
	Optimal poly.	Local linear	Optimal poly.	Local linear	Optimal poly.	Local linear	Optimal poly.	Local linear	Optimal poly.	Local linear	Optimal poly.	Local linear
Above	-0.028*	-0.017	-0.026**	-0.017*	-0.026	-0.018*	-0.028**	-0.018*	-0.007	-0.000	-0.008	0.001
	(0.015)	(0.011)	(0.013)	(0.010)	(0.018)	(0.010)	(0.014)	(0.010)	(0.007)	(0.004)	(0.007)	(0.004)
Degree of opt. poly.	2		2		3		2		3		3	
Observations	20483	20483	20483	20483	20483	20483	20483	20483	20483	20483	20483	20483

Notes: Same working sample as in Table 1 Panel A.
Each column corresponds to a specific dependent variable, considering the same six outcomes as in Table 1.
For each dependent variable, the first row replicates the analysis in Table 1 Panel A with different sets of control variables, namely without any control variable for students' baseline characteristics (columns 1, 3, 5, 7, 9, 11), or with control variables for all available students' baseline characteristics (columns 2, 4, 6, 8, 10, 12).
The second row replicates the analysis in Table 1 Panel A with alternative functional forms; that is, columns 1, 3, 5, 7, 9 and 11 report the results of falling above the admission threshold using a polynomial function of the running variable whose optimal order is obtained by a bins test; and columns 2, 4, 6, 8, 10 and 12 report the results using local linear estimations.
All estimates include triangular weights, and standard errors clustered at the individual level are given in parenthesis.
* significant at 10%. ** significant at 5%. *** significant at 1%.

Table A6: Repetition Decisions, Eligibilty at Last Participation, and Ranking Differential

	Repetition	Non eligible at last part.	Ranking diff.	Ranking diff. (unadjusted)
	(1)	(2)	(3)	(4)
Panel A: Reduced form estimates				
Above	-0.017**	0.002	-0.615*	-0.371
	(0.008)	(0.003)	(0.336)	(0.255)
Mean at the thresholds	.133	.00897	4.97	3.1
N	26724	26724	26491	26491
Panel B: IV estimates		-0.088	33.210***	19.727**
		(0.164)	(8.940)	(9.249)
N		26724	26491	26491
Panel B: Non-marginal repeaters		0.103***	38.550***	23.576***
		(0.015)	(0.929)	(1.037)
N		389	349	349

Notes: The table refers to sample of participants who for the first-time entered the MP competition (math and engineering tracks) between 2012 and 2016.
Each column corresponds to a specific dependent variable, namely a dummy indicating year repetition (column 1), a dummy indicating eligibility for the oral examinations at last participation (column 2), the difference in standardized rankings between first and last attempts (column 3), and the difference in standardized rankings between last and first attempts using rankings that are not adjusted for the bonus of points granted to first-time participants (column 4). For columns 3 and 4, the samples exclude the students who were not ranked on their last attempt (i.e., not eligible for the oral examinations at last participation).
For each dependent variable, Panel A shows the estimated impact of falling just above the admission threshold, while Panel B provides the corresponding IV estimates of the impact of repetition, i.e., the estimated effects of repetition when we use falling just above the admission threshold as instrumental variable.
Standard errors clustered at the individual level are given in parenthesis. Each cell corresponds to a specific regression using the same specification and control variables as in Table 1.
In addition, Panel C reports the mean of each dependent variable for the sample of repeaters whose initial standardized ranking fell just above an admission cutoff point (i.e., between the cutoff and 5 percentiles above).
* significant at 10%. ** significant at 5%. *** significant at 1%.

Table A7: Repetition Decisions and Achievement Gaps in Elite Science Competitions

	Women	Men	Gender gap	Low-income students	High-income students	Income gap
	(1)	(2)	(2) - (1)	(3)	(4)	(4) - (3)
Top 15% at first attempt	0.127	0.156	-0.029	0.081	0.184	-0.103
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 15% with repetition for low-income students	0.126	0.156	-0.030	0.092	0.178	-0.086
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 15% with repetition for women and low-income students	0.136	0.154	-0.018	0.091	0.179	-0.089
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 15% at last participation	0.125	0.157	-0.032	0.083	0.183	-0.100
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.004)
Top 25% at first attempt	0.210	0.261	-0.051	0.149	0.300	-0.150
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Top 25% with repetition for low-income students	0.209	0.261	-0.052	0.170	0.290	-0.120
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Top 25% with repetition for women and low-income students	0.229	0.256	-0.027	0.165	0.292	-0.126
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Top 25% at last participation	0.207	0.261	-0.054	0.148	0.300	-0.153
	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.005)
Observations	6214	22992	29206	9673	19533	29206

Notes: The table reports similar results as Table 2 using standardized rankings that are not adjusted for the bonus of points granted to first-time participants.

Appendix B

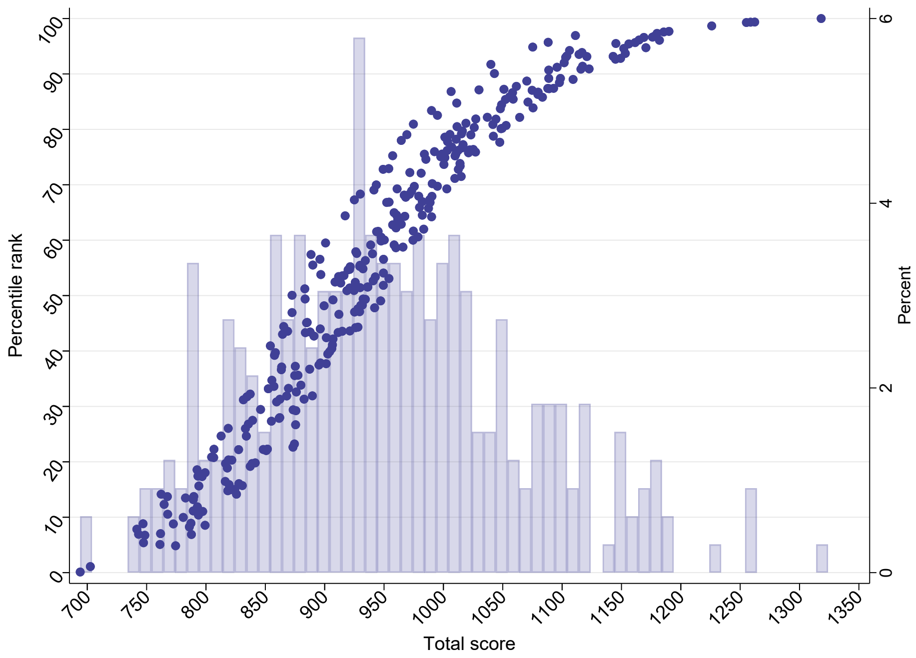


Figure B1: Correspondence between Scores and Rankings at the MP Competition

Notes: The figure refers to a specific Parisian prep school program for which we have full information on both student's scores and student's (standardized) rankings at the MP competition between 2012 and 2017. For the different observed scores, the dots report student's standardized rankings. In addition, the histogram shows the density of observed scores. We first used this correspondence between scores and rankings to infer the scores of all participants in the MP competition based on their standardized rankings. We were then able to adjust scores for the bonus of points granted to first-time applicants and to re-rank students based on their adjusted scores. We used these adjusted rankings to define outcomes corrected for bonus points.