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Advising students on their field of study: Evidence from a French University reform ☆

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ABSTRACT

This paper measures the effect of a policy implemented in France in 2009 advising students on their field of study at university. Applicants receive reviews from universities on their chances of graduating, which are determined relative to their numerical grades in high-school. To measure the causal impact of the reviews on the choice of their field of study, we compare students with similar high-school numerical grades but different reviews in a regression discontinuity framework. From a database of first year undergraduate applicants, we estimate that receiving a positive signal in a given field of study has little impact on the probability of registration, while receiving a negative signal in a given field decreases the proportion of students enrolling in this field by 14 percentage points.

1. Introduction

The choice of post-secondary education plays a critical role in determining the future earnings of university graduates. When students apply to a university, they need to gather information from the various higher education institutions. Yet, a large body of literature documents that students have a poor level of information regarding higher education (see in particular Altonji et al., 2016, and Scott-Clayton, 2012). Moreover, senior high-school students may make uninformed choices if they do not have an accurate perception of their own ability to succeed in a given field of study. In fact, Bettinger et al. (2009) report that many high-school graduates entering higher education are unprepared academically for the field in which they have chosen to study. In this respect, a policy assisting high-school students to better choose their field of study may be potentially highly beneficial.

In this paper, we evaluate the impact of such a policy. We present evidence to suggest that providing information to university applicants on their likelihood of success in a given field of study influences their decision to enroll in that specific field. A policy called *Active Orientation* (henceforth AO) was implemented in France in September 2009, with its objective to help senior high-school students choose their field of post-secondary education. More precisely, AO requires that within each university, high-school students may benefit from advice on the field of study of particular interest to them in order to provide the best match with their previous high-school academic records. Information delivered to potential first year students consists of a positive, neutral or negative assessment by university officers of their ex-ante probability of graduating, conditional on their high-school academic records. It is not a part of any official selection process to screen the best applicants and deter the weaker ones, since in France, universities are not permitted to select first year students.

Analyzing the impact of the AO policy, we focus on enrollment decisions and the choice of a field of study. First, the main objective of the AO policy reform is to influence the choice of major at university level. As described in more detail below, in France students can freely choose their university and major. There is a general concern that many first year undergraduate students may make an unwise enrollment decision, by choosing a subject major that does not fit with their academic level. A first evaluation of the reform should concentrate on its expected effect. Second, considering alternative outcomes such as their likelihood of graduation, would be rather indirect, although, enrollment and university major choice effects derive from a straightforward approach and a cleaner empirical strategy.

However, it is difficult to estimate a university enrollment equation, since many determinants of university attendance are not observed by the econometrician. Students with the best academic records in high-school have, at the same time, the best outside options. Computing the regression of university attendance on the review sent to students

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would likely provide biased estimates, since information delivered at university entrance and outside options are both positively correlated with high-school academic records. To overcome this limitation and to interpret our results as causal, we exploit a quasi-experimental source of variation in the review determination process. Student counseling is simply related to students' past academic outcomes. Above a specific numerical score in high-school grades the probability of getting a positive signal jumps significantly. We use this discontinuity to estimate the causal effect of the review on university attendance. Empirically, we work in a fuzzy regression discontinuity design (RDD) framework (Hahn et al., 2001). We implement global and local RDD estimators on a large administrative dataset of university applicants to a single institution in France, and conclude that sending negative feedback to university applicants has a strong deterrent effect, decreasing enrollment probability in that field by 14 percentage points. The effect is large and statistically significant.

Over recent years, a growing body of literature has emerged studying the impact of information on schooling decisions. This literature is surveyed in Altonji et al. (2012) and Altonji et al. (2016). Several studies propose natural or field experiments on this issue; Hastings and Weinstein (2008) use such strategies. They confirm the positive effects of information on the quality of a university and attendance rates. Avery (2010) runs a randomized controlled trial to measure whether or not counseling high-ability, low-income high-school students increases university attendance. The results show that it indeed does influence the choice of where students apply to attend university. Bettinger et al. (2012) use a randomized field experiment to test whether or not assisting low-income students to complete scholarship application forms increases Federal Student Aid and university attendance. They conclude that the university enrollment rate increases by eight percentage points. Carrell and Sacerdote (2013) randomly assign college mentoring services to high-school students, and find a significant impact on the decisions of women in particular, to enroll in college. Wiswall and Zafar (2015) provide average salary information to first year students and look at the change in their choice of major. They confirm the importance of unobserved taste factors.

Another branch of the literature develops structural models for schooling decisions. Arcidiacono (2004) estimates a dynamic model of university and choice of major in which students are uncertain about their abilities. In this model, students update their beliefs about their ability after observing their grades. Stinebrickner and Stinebrickner (2014) propose a dynamic learning model of university dropouts. They show that nearly half of the dropouts from university can be attributed to students learning about their academic performance. With regards to French data, Beffy et al. (2012) estimate a sequential schooling decisions model. Students choose their major comparing expected earnings and the non-monetary characteristics of each major.

Finally, in a companion paper Hestermann and Pistolesi (2016) evaluate the same policy under an alternative empirical strategy. They compare students applying to different departments within the same university; some provide feedback to any candidate, while others do not. They find that the probability of registering is reduced by about seven percentage points among the applicants who receive a negative signal.

This article contributes to the literature in several respects. The first contribution is to measure the causal impact of providing information to students on their skills in relation to their enrollment decisions. As mentioned above, recent evidence demonstrates that students can have poor prior knowledge of their own skills. In this paper, we test whether or not students update their choice of major after receiving positive or negative feedback. The second contribution is in the use of an administrative dataset of approximately 62,000 applicants to a single university. From our main sample, we focus on a narrowly defined set of around 13,000 applicants. Therefore, the identifying assumptions of continuity at the threshold of the RDD framework seem less restrictive (Lee, 2008). Finally, the third contribution of our paper is to provide local treatment effects for two different messages. The first provides a negative assessment on the student's chances of graduating, while the second is more optimistic on the students likelihood of graduating. We show that students react very differently to these two messages, providing a rich picture of the impact of such a policy.

The rest of the paper is organized as follows. Section 2 describes the policy under investigation and the data used for the analysis. Section 3 presents the empirical strategy. In Section 4, we detail the results. Finally, Section 5 concludes.

Table 1
Applications and Enrollment to Higher Education in France.

	University	Elite Schools	Professional Tracks	Others
Initial choice applications (%)	0.26	0.10	0.55	0.09
Final Enrollment (%)	0.51	0.10	0.29	0.10

Sources: MSER (2012) page 11 Table 1 and MSER web site. The first row of the table indicates the proportion of first choice applications from senior high-school students to first year undergraduate studies between 2010 and 2012 using the APB website. The second row reports the proportion of enrolled students over the same period. The difference between the two rows represents the share of students that have to change their enrollment since they are not admitted to elite schools or professional tracks.

2. Institutional background and data

In France, post-secondary education is divided into three main types of institutions: university, elite schools and professional tracks. Enrollment procedures are determined differently by each of these types of institutions. University is non-selective, while elite schools and professional tracks are selective institutions. In this section, we present the French system and explain why the AO policy has been implemented.

2.1. Access to higher education in france

Within France, universities are public institutions. They provide general non-professional teaching in most fields. They offer low tuition costs of 184 euros annually at the undergraduate level and 256 euros at the graduate level (MSER, 2012). Universities receive funding from the Ministry of Higher Education. Additionally, there is no selection process for first year undergraduates. As a consequence, any student graduating from high-school is entitled to register at the university of his choice. As tuitions fees are low, university attracts a large share of students. As shown in Table 1, approximately 51% of a cohort of students enroll in universities (MSER, 2012). Elite schools can be either selective public or private institutions;[1] they are business or engineering schools. A small fraction of students enroll in these very selective institutions, representing around 10% of a cohort. professional tracks are mostly public institutions that provide shorter tracks, from two to three years, and concentrate on technical fields.[2] These are selective institutions. Around 29% of students enroll in these professional tracks each year.

Reforming access to university

Two main reasons have led the Ministry of Higher Education to create the AO policy. First, as Table 1 indicates, many students register for university but do not select it as a first choice. Often, they have not been accepted to selective institutions, such as the elite schools and professional tracks. Comparing the proportion of first choice applications in the first

[1] In order to enter elite schools, 70% students attend CPGE, *Classes Prparatoires aux Grandes Ecoles* for two years; 18% come from universities and 12% from professional tracks (MSER, 2012).

[2] Professional tracks are called BTS-IUT, which means *Brevet de Technicien du Supérieur* and *Institut Universitaire de Technologie*.

row, with the proportion of enrolled students in the second row, more than 65% of applicants choose to apply, as a first choice, to selective tracks (10% +55%), while only 39% (10%+29%) students are admitted to these institutions. As a result, 25% (51–26%) attend a university which they did not select as their first choice. A direct consequence of this non-selective higher education system with open admission is that the drop-out rate at the end of first year is very high. As demonstrated in Gury (2007), around 60% of a cohort fail at the end of the first year exams, and 23% of students leave the higher education system without any diploma. This system has a huge social cost since many students lose one year trying different fields with the universities financing large undergraduate programs. In order to improve the system without allowing universities to select their students, policy-makers have created *Active Orientation*. This policy has been designed to assist senior high-school students to select a field of study at university most suited to their academic grades.

This study concentrates on access to universities, which are the only non-selective institutions and receive by far the largest share of students. Students applying to universities are much more representative of the full population than elite schools or professional tracks, which concentrate on a very select subgroup of students: high achieving students on the one hand; and students preferring professional tracks on the other. More importantly, the reform evaluated here has been especially designed to improve the allocation of students to university. In the next section, we detail the AO policy.

2.2. The active orientation policy

In 2008, the French Ministry of Higher Education created a website, called *Application Post-Bac* (henceforth APB), to manage admissions into higher education. Each year, from January to April, senior high-school students access the website and provide a list of up to 16 tracks for the following academic year when they enter higher education. A track is defined as a field of study within an institution. In July, high-school graduates can see where they have been admitted to amongst the selective tracks. They can then choose to register there or to select any non-selective track they had initially listed. This electronic system represents a simple, costless and unified procedure in order to manage higher education admissions. The way in which the APB website is organized has two major consequences. First, students have an incentive to list at least some non-selective tracks in order to be certain of gaining access to higher education. Therefore, the initial choice of which non-selective tracks to list is important. Second, the ranking of the choices does not play a crucial role, since students are automatically admitted to any non-selective track.[3]

Active Orientation (AO), is a national policy initially implemented in France in September 2009 in order to assist senior high-school students to select a field of study at university corresponding to their past academic records. In this respect, AO requires universities to deliver recommendations between April and May, on their field of study to senior high-school students before they register. The reviews sent to students are purely informative, and they do not represent any selection mechanism. As already discussed, it is generally admitted that many students register in their first year undergraduate program without a clear idea of whether or not their skills will fit within the academic level of the field they have chosen. In this paper, we measure whether or not the AO policy has any effect in changing enrollment decisions when feedback from university officers is provided.

The reviews are sent by universities to their applicants through the APB website. These reviews are determined independently by each department of any university.[4] The departments can choose to send a review to any candidate as in the present study or only to those asking for one.[5] The reviews are determined by a rule that depends on high-school academic grades. Each department is free to set its own rules, for example, at the Department of Economics of the University of Toulouse, high-school grades in mathematics are considered to be a good predictor for future academic success. The Department of Economics has thus set fixed cutoffs on the numerical score in mathematics in order to determine the signal applicants receive. As rules are changing across departments and universities, this paper concentrates on students applying to a given department of a given university. Using variations in the reviews across universities or departments would raise important issues of comparability. Our identification strategy exploits cross-sectional variation and the discontinuous jump created by the cutoffs of high-school numerical grades when the reviews sent by university are determined.

The reviews contain three possible messages: negative, neutral and positive. Appendix A provides the exact formulation that has been used, which are short and are unlikely to be misunderstood. The positive review states that the student's academic records seem adequate in order to be able to succeed in a particular field. The neutral review states that it is difficult to predict the student's graduation chances, but with work graduation is possible. The negative signal indicates that it appears difficult for the student to succeed in this particular field of study considering their previous academic records. In this particular case, the student is advised to change their choice of post-secondary education. Applicants receive the reviews during the month of May and graduate from high-school in early July.[6]

In this framework, several potential concerns could affect our analysis. First, students and teachers could have incentives to manipulate the numerical scores in order to be on the *right* side of the threshold. Students can clearly affect their grades, though they do not choose them completely. Only precise control of the running variable would affect the validity of the analysis. Moreover, grades are set on the APB website by high-school principals and not by students. Teachers are unaware of the specific thresholds and subjects chosen by the university. Finally, as the review is purely informative, it is unclear why a student would try to influence which signal she would receive.[7]

A second potential threat relates to the existence of other policies that are determined by the same cutoffs. As detailed below, the two cutoffs in the math numerical score are 10 and 12. These two values are the cutoffs in the crosswalk between numerical scores and the assignment of honors. A grade of 12 is the cutoff for *Assez Bien*, the third highest honors category, a numerical grade of 10 is the cutoff for *Passable*, the fourth highest category, with all grades below 10 corresponding to *Insuffisant*. Thus students at 9.9 and 10.1 would not be comparable. The same argument would indicate that students at 11.9 and those at 12.1 would be very different. In this setting, the regression discontinuity design would be invalid. However, the link between grades and honor categories is valid only at the end of high-school exam, called the *Baccalauréat*. The different honor categories have no meaning for individual grades such as the mathematics score used in this experiment. In the *Baccalauréat* exam, the numerical score is computed as the weighted average of nine different tests. These tests take place at the end of the senior high-school year. Honors related to the result of *Baccalauréat* do not depend on grades attributed during

[3] Students ca list for example “Mathematics in at the University of Bordeaux, Economics at the University of Montpellier or Economics at the University of Toulouse, in any order, since at in any of these institutions they are automatically accepted.

[4] If a student applies to two different departments in a given university, or to two different universities in the same field she will receive two different reviews, one from each of the departments.

[5] The former is called *orientation pour tous*, the latter is called *orientation solicite*.

[6] A detailed presentation of the policy in French is presented on http://www.etudiant.gouv.fr/cid23483/orientation-active-admission-post-bac.html

[7] In Section 4.1 we extensively study the validity of the design and we test for any discontinuity in the density of the math grade distribution using McCrary (2008) procedure. We do not detect any discontinuity at the thresholds. In Appendix A.III, we present regressions of the math grade on individual and school characteristics. Both are significant in the determination of the numerical score. High-school quality difference measured by graduation rate of the end of high-school exam or school fixed effects affect math scores. We always use controls for individual and school characteristics in the empirical analysis to net out the observable differences.

the academic year.[8] In this context, the mathematics score determining reviews does not determine honors and this potential threat is less concerning. From the teacher's perspective, it could still be the case that the grading below and above one of these two cutoffs has a different meaning. The analysis to follow is valid under the assumption that there is some random component in the grading of students that drives comparable students at random around the 10 and 12 numerical scores.

A third potential concern affects our analysis. Alternative institutions can use the same thresholds to determine their reviews, in which case, our measured policy effect could be difficult to interpret. While only a comprehensive dataset would formally make it possible to reply to this concern, this case is unlikely for two reasons. First, in France, many undergraduate students enroll in the closest university to their place of residence. Few consider moving to a different city. As detailed below, more than two third of applicants live in a regional district that does not include any other university; they live, on average, 160 km from the university which is relatively close. Second, other departments from the same university use quite different criteria to advise their applicants. For example, the Law and the Management departments from the same university use the high-school major providing a positive review to those having a major in high-school in Sciences, Arts or Economics. They provide a negative review to those with vocational majors and a neutral review to those applying from abroad. Overall, we interpret these elements as evidence that the discontinuity that we observe between the enrollment rate and the mathematics numerical score is directly related to the AO policy under study. The next section describes the data.

2.3. Data and descriptive statistics

In this paper, we have access to a subset of the APB data restricted to the applicants at the University of Toulouse. Applicants are those who listed the University in their wish-list in APB from January to April. This sample is held at the University, and we have no access to the national database covering the full population of senior high-school students in France. The APB website collects individual information on age, sex, place of residence, place of birth, nationality, high-school location, type of high-school (private vs public and general vs technical), and major in high-school (sciences, economics, arts or vocational). We also have information on foreign languages studied and any optional courses each student has followed in high-school. High-school administrators upload to the APB website any academic record over the last two years for the different terms and subjects.[9] Overall, we have data on six cohorts of students potentially enrolling at the University of Toulouse from 2008 to 2013. Each year about 10,000 individuals list this university on the APB website as an institution they would like to register at in the following academic year. Finally, around 3000 register at undergraduate one level each year.

These data are matched with the University internal records including any first year student registered in one of the departments of the University. The University has three main departments: Law, Economics and Management. We match the data on a unique national schooling identifier. We build our outcome variable as a dummy variable taking the value one if in the following year the applicant registers in the Department of Economics at the University of Toulouse, and zero otherwise. The university records include information on full name, sex, date of birth, a six digit national identifier, occupational group of the father, nationality, department of the university in which the student has registered, major and minor subjects, and the year in which the student obtained their end of high-school diploma.

For the purpose of this analysis, we complement these samples with other data sources. First, to estimate the enrollment equation more precisely, we build a measure of geographical distance between the place of residence and the university. We observe the exact place of residence and compute the shorter distance by road between these two places as a proxy for commuting time. We use it as a control variable in the equation of interest describing attendance decisions. Second, as detailed below, grades in high-school are not the only determinant factors of reviews, and university officers are allowed to consider other information (such as high-school quality, grades from earlier years or from other subjects), should they find it difficult to grade an applicant. Additionally, applicants are permitted to write a few sentences to explain their motivation, however, very few students use this possibility. We measure high-school quality by the graduation rate of the *Baccalauréat*. This information is extracted from the dataset *Indicateur de résultat des lycées* for every high-school.

Samples

We restrict our analysis to applicants at the Department of Economics at the University of Toulouse in the first year undergraduate program between 2009 and 2013, and living in France. In 2008, the APB website collected data but no review was given since the AO policy started one year later.[10] In the main sample, we do not consider applicants in other departments of the University of Toulouse since the rules determining reviews change. More importantly, in other departments of the University, reviews are provided only if students deliberately ask for them. Using these applications in our analysis would introduce some self-selection that would make the results difficult to interpret. However, we can still use these observations for a falsification test since we should not observe a reduced form effects for these individuals since they did not receive a review from the Department of Economics. The main sample is restricted to individuals living in metropolitan France. Those living in foreign countries face very different outside options and moving costs. We lose 146 observations with missing values on key variables. The Appendix Table A.i details the number of observations that we eliminate at the different steps. Finally, the main sample of our analysis includes 12,739 individual observations where each has applied and received a review from the Department of Economics of the University of Toulouse between 2009 and 2013.

Table 2 displays descriptive statistics for the main variables used in the analysis. The first column reports mean characteristics for the full sample. The second and the third columns split the sample between the applicants registering and those not registering at the Department of Economics at Toulouse. The fourth column tests the equality of the means for each characteristic. From the table, 33% of the students receive a positive signal, while 41% of them receive a negative one. The remaining 26% receive a neutral review. As the table shows, many individual characteristics differ between the students enrolling and those not-enrolling in Economics at the University of Toulouse. The share of students receiving a negative feedback is significantly smaller among those enrolling (40% vs 42%), while the share of those receiving a positive review is higher (34% and 32%). The students enrolling in Economics are, on average, younger, and more often have a major in Economics from high-school (55% vs 46%). They also more often come from public or general high-schools. Finally, 5037 students are elected to register in the field of Economics representing 39% of applicants.

Comparisons of university applicants in Economics at the University of Toulouse around small intervals at the two different thresholds are shown in Table 3. As explained below, the first cutoff at 10 points in the math grade determines the likelihood of receiving a

[8] More details can be found at http://en.wikipedia.org/wiki/Academic_grading_in_France

[9] The academic year is divided into three terms. Individuals register within the second term of the final year of high-school therefore we only observe the grade of the three terms for the penultimate year and the first two term for the final year.

[10] We use this pre-policy data as a placebo experiment in the robustness section of the paper.

Table 2
Descriptive Statistics by Enrollment Status.

	Full Sample	Enrolled in Econ. at Toulouse	Not Enrolled in Econ. at Toulouse	p-value
	(1)	(2)	(3)	(4)
Positive Review	0.33	0.34	0.32	0.01
Negative Review	0.41	0.40	0.42	0.00
Math grade in h-school	11.60	11.52	11.65	0.00
Math grade in h-sch. (prev. year)	11.73	11.66	11.77	0.00
Age	18.68	18.64	18.71	0.00
Male	0.56	0.56	0.57	0.56
French citizenship	0.93	0.92	0.93	0.43
Scholarship	0.17	0.18	0.16	0.00
Living in local district	0.45	0.54	0.40	0.00
Grade rep. in h-school	0.13	0.15	0.12	0.00
Major in h-school: Economics	0.50	0.55	0.46	0.00
Major in h-school: Sciences	0.39	0.37	0.40	
Major in h-school: Arts	0.02	0.01	0.02	
Major in h-school: Other	0.10	0.06	0.13	
Foreig. Language English	0.87	0.88	0.87	0.00
Foreig. Language German	0.03	0.03	0.04	
Foreig. Language Spanish	0.05	0.06	0.05	
Foreig. Language Other	0.04	0.04	0.05	
Distance from h-school to University	0.16	0.11	0.19	0.00
General h-school	0.92	0.93	0.91	0.00
Public h-school	0.79	0.82	0.76	0.00
Applies in Economics	1.00	1.00	1.00	0.00
Applies in Law	0.26	0.33	0.22	
Applies in Management	0.30	0.35	0.27	
Observations	12,739	5037	7702	

Notes: The table indicates the mean characteristics for the full sample, for subsample of applicants registering in Economics at Toulouse and for those who do not. The last column is the p-value for the test for the equality of means in columns (2) and (3). Positive (resp. Negative) Review: indicator for individuals receiving a positive (resp. negative) feedback from their application to university. Math grade in h-school: means grade in mathematics during the last year in high-school. Math grade in prev. year: mean grade in mathematics during the penultimate year in high-school. Scholarship: indicator for receiving a scholarship in high-school. Local district: Living in Haute-Garonne. Regional district: Living in Midi-Pyrénées region. Foreign language: reference other. Distance to university: (/1000 km) from high-school to university. General h-school: indicator for general high-school (reference: Professional high-school). Public h-school: indicator for public high-school (reference: private high-school).

Table 3
Comparison of Applicants Around the Cutoffs.

	Cutoff 1: Math. Grade=10			Cutoff 2: Math. Grade=12		
	cutoff-0.5	cutoff+0.5	p-val.	cutoff-0.5	cutoff+0.5	p-val.
Positive Review	0.08	0.12	0.00	0.25	0.55	0.00
Negative Review	0.81	0.44	0.00	0.32	0.25	0.00
Enrolled in Econ. at Toulouse	0.38	0.45	0.00	0.40	0.38	0.23
Math grade in h-school (year N)	9.75	10.25	0.00	11.73	12.24	0.00
Applies in Law	0.27	0.25	0.33	0.25	0.25	0.89
Applies in Management	0.35	0.33	0.24	0.33	0.30	0.16
Age	18.94	18.82	0.01	18.59	18.54	0.17
Male	0.65	0.64	0.54	0.54	0.53	0.74
French citizenship	0.93	0.93	0.64	0.93	0.92	0.28
Scholarship	0.20	0.17	0.13	0.15	0.16	0.48
Grade rep. in h-school	0.17	0.15	0.10	0.11	0.11	0.94
Local District	0.43	0.46	0.25	0.45	0.46	0.45
Distance to university	0.18	0.16	0.27	0.16	0.16	0.62
General h-school	0.91	0.92	0.36	0.92	0.91	0.34
Public h-school	0.75	0.78	0.16	0.78	0.80	0.49
Major in h-school: Economics	0.45	0.50	0.01	0.53	0.51	0.71
Major in h-school: Sciences	0.37	0.38		0.39	0.41	
Major in h-school: Arts	0.02	0.02		0.01	0.01	
Major in h-school: Other	0.16	0.11		0.07	0.07	
Observations	881	1126		1178	1075	

Notes: The table indicates the mean characteristics of observations on the right and on the left of the two cutoffs. Columns 3 and 6 are p-values for t-tests of equality on the two sides of the cutoffs.

negative review relative to a neutral or a positive one. Results show that 81% of students just below 10 receive a negative signal compared to only 44% of those just above 10. At the second cutoff of 12 points in the mathematics grade the share of applicants in Economics with positive feedback jumps from 25% to 55%. There remain some applicants in this field receiving a positive review while their math score is lower than 10, around 8%. These are students from prestigious high-schools or with very good grades except in mathematics. As a consequence, reviews are not a deterministic function of the mathematics score; rather, 25% of students with a grade just above 12 receive a negative review, and while achieving well in mathematics they attain low grades in other subjects. There are some differences in university enrollment in Economics on the two sides of the first threshold, from seven percentage points at the first cutoff, but only two percentage points at the second. Applicants in this field just below the first threshold are less likely to register than those above it (38% vs 45%) while at the second cutoff the probability changes slightly from 40% to 38%. It is possible that, for lower ability students, i.e., at the first cutoff, receiving a negative signal acts as a deterrent, while for higher ability students, i.e., at the second cutoff, the better students have more outside options and do not consider the signal they receive. In the empirical section, we will test if the observed difference in enrollment in Economics at the University of Toulouse is causally linked to the signal. There is a slight imbalance at the first threshold in the mean age (p-value 0.01) and in the distribution of majors in high-school (p-value of 0.01), otherwise observables are fairly balanced on each side of the two cutoffs.

Finally, we describe more precisely how the reviews are determined. As explained above, the mathematics grade in high-school plays an important role, however it is an imperfect measure of schooling ability. Human capital is multi-dimensional and students skills' vary within these different dimensions. High verbal ability can compensate for lower mathematics ability. We measure the grades in high-school in four different topics: Mathematics, Sciences (biology and physics), Humanities (French, history and philosophy) and Foreign Languages, and we assess their impact on the reviews sent to the university applicants.[11] In Table 4, the first column displays the linear regression of a dummy variable taking the value one for those receiving a negative review and zero for those receiving a positive or neutral review on individual and high-school characteristics. The second column shows the linear regression of a dummy for those receiving a positive review relative to a neutral or negative one on the same observables characteristics. In both regressions, we interact high-school characteristics with high-school grades. From this table, we see that the mathematics grade is the most important determinant of the review. Increasing the mathematics grade by one point over 20 changes the probability by 10 percentage points in the two regressions. In comparison, the other high-school grades play a minor role in the review determination process. The major in high-school is another important determinant of the review. Individuals coming from a major in economics or science decrease their probability of receiving a negative review by 20 percentage points. High-school characteristics and their interactions with individual grades by category play a minor role in determining reviews. Overall, these observables represent between 25–30% of the variance in the reviews only.

3. Identification and estimation

Our analysis examines the effect of providing feedback to high-school students on university applications in a given field of study. Signals sent to students are designed to assist students to choose the field that best corresponds with their past academic records. As detailed below, for each application in a given field of study, the university can provide three possible reviews: negative, neutral or positive, depending on previous schooling achievement. The higher the academic grades in high-school, the more likely an applicant is to receive a positive signal and the less it is that she will receive a negative one.

To identify the effect of the review on enrollment decisions in a given field we exploit exogenous variations in reviews originating from the deterministic rule relating feedback to mathematics grade in high-school. Let W_i^1 denote a dummy variable taking the value one for receiving a negative review and zero for a neutral or positive one for student i. A simple framework to measure the effect of the negative

[11] For each topic we compute the average of the different components (e.g., history, French and philosophy are added and the mean is computed and called the Humanities grade) over the first term of the last year in high-school.

Table 4
Regression of Reviews on Individual and High-school Characteristics.

Dep. Var:	Negative Review	Positive Review
H-sch. grade: Math	−0.108 (0.007)	0.104 (0.006)
H-sch. grade: Science	−0.017 (0.029)	0.038 (0.026)
H-sch. grade: Humanities	−0.015 (0.036)	0.021 (0.033)
H-sch. grade: Foreign language	0.016 (0.038)	−0.016 (0.035)
Age	0.003 (0.005)	−0.006 (0.004)
Male	0.009 (0.008)	0.000 (0.007)
Repeating a year in h-school	0.028 (0.012)	0.006 (0.011)
French citizenship	−0.052 (0.015)	0.023 (0.014)
Scholarship	0.009 (0.010)	−0.010 (0.010)
Major in h-school: Economics	−0.200 (0.014)	0.067 (0.013)
Major in h-school: Sciences	−0.226 (0.014)	0.108 (0.013)
Major in h-school: Arts	−0.101 (0.033)	0.011 (0.031)
General h-school	0.065 (0.089)	−0.232 (0.083)
Public h-school	−0.072 (0.067)	0.141 (0.062)
H-sch. graduation rate	−0.004 (0.003)	−0.002 (0.003)
General h-sch.*math grade	0.003 (0.007)	0.017 (0.006)
General h-sch.*science grade	0.009 (0.006)	0.002 (0.006)
General h-sch.*humanities grade	−0.003 (0.008)	−0.008 (0.007)
General h-sch.*Foreign lang. grade	−0.014 (0.009)	0.011 (0.008)
Public h-sch.*Math grade	−0.000 (0.005)	−0.002 (0.004)
Public h-sch.*Science grade	0.001 (0.004)	−0.004 (0.004)
Public h-sch.*Humanities grade	−0.000 (0.005)	0.004 (0.005)
Public h-sch.*Foreign lang. grade	0.005 (0.006)	−0.009 (0.005)
H-sch. graduation rate*Math grade	−0.003 (0.017)	−0.012 (0.016)
H-sch. graduation rate*Science grade	0.000 (0.000)	−0.000 (0.000)

(continued on next page)

Table 4 *(continued)*

Dep. Var:	Negative Review	Positive Review
H-sch. graduation rate*Humanities grade	0.000	−0.000
	(0.000)	(0.000)
H-sch. graduation rate*Foreign lang. grade	−0.000	0.001
	(0.000)	(0.000)
Constant	2.096	−0.694
	(0.322)	(0.299)
Observations	12739	12739
R^2	0.246	0.290

Notes: The table indicates the OLS estimates of individual and high-school characteristics on the review received. The first column displays estimate for the negative review, the second for the positive review. High-school grades are divided into four categories: mathematics, Science (biology, physics), Humanities (history, French and philosophy) and Foreign Languages. Individual characteristics include age, sex, grade repetition, nationality and scholarship. School characteristics are measured by high-school graduation rate, public or private, and general or technical high-school status.

review on university enrollmeWrite the 2 equations on different rows, the first is (1), the second as no numberingnt is given by:

$$y_i = \beta_0 + \beta_1^1 W_i^1 + x_i'\delta + \epsilon_i, \qquad (1)$$

$$W_i^1 = \gamma_0 + x_i'\gamma + u_i,$$

where y_i is a dummy variable taking the value one if individual i registers in the department of the university providing the review, and zero otherwise. x_i is a vector of observed individual and high-school characteristics, ϵ_i and u_i are unobserved determinants of enrollment in this field and of the negative review received, respectively. However, estimating Eq. (1) by OLS is unlikely to provide consistent estimates. It is highly likely that unobserved determinants of y_i and W_i^1 are correlated, namely $E(\epsilon_i u_i) \neq 0$, providing biased OLS estimates.

Several reasons may explain this situation. First, we do not observe every determinant used by the university reviewers to evaluate high-school students. If some unobserved determinants are at the same time correlated to the likelihood of entering university we would get biased estimates. Hence, high-school reputation plays a role in the determination of reviews. We control for high-school quality with the graduation rate at the end of high-school exams but this is a rough measure of school quality. Omitting to control for these factors, an estimate of β_1^1 would not provide an effect of the review on university enrollment net of these effects. Second, as discussed in Van der Klaauw (2002), in the data collected by a university during their admission process, for the majority of the time, information is not collected about the applicants' outside options. Clearly, a student with better high-school grades will have more alternatives to choose from. Missing data on outside options is likely to cause an omitted variable bias in estimating the effect of a review on university enrollment in a field of study.

To overcome these potential identification issues, we use the exogenous variation in the review induced by the rule determining how it relates to high-school academic grades. As discussed above, the review is partly determined by a discontinuous function of the high-school grades. If enrollment decisions are smoothly related to other characteristics at the grade cutoffs, we can then estimate the effect of the review on university enrollment by comparing individuals just below and above the cutoffs. Let G_i be the students' mathematics high-school grade and $\overline{G_1}$ be the grade level below which the probability of getting a negative review jumps. We could estimate the following model by two-stage least square:

$$y_i = \beta_0 + \beta_1^1 W_i^1 + h(G_i) + x_i'\delta + \epsilon_i. \qquad (2)$$

$$W_i^1 = \gamma_0 + \gamma_1 1\{G_i > \overline{G_1}\} + h(G_i) + x_i'\zeta + u_i, \qquad (3)$$

where $1\{\cdot\}$ is an indicator function taking the value one if the condition is true, and zero otherwise, and $h(\cdot)$ is a polynomial function of the high-school grade. The function $h(\cdot)$ captures the relationship between the mathematics grade and enrollment decision in this field away from the threshold. In the empirical application, we provide different specifications for $h(\cdot)$ as a polynomial from order one to four.[12]

To measure the causal effect of the positive review on university enrollment, we use a symmetric approach, denoting W_i^2 as a dummy variable taking the value one for a positive review and zero for a negative or neutral one. $\overline{G_2}$ is the mathematics grade above which the probability of getting a positive review jumps, with $\overline{G_2} > \overline{G_1}$. We estimate the following model, to assess the enrollment effect of a positive review:

$$y_i = \beta_0 + \beta_1^2 W_i^2 + h(G_i) + x_i'\delta + \epsilon_i. \qquad (4)$$

$$W_i^2 = \gamma_0 + \gamma_1 1\{G_i > \overline{G_2}\} + h(G_i) + x_i'\zeta + u_i. \qquad (5)$$

In the empirical analysis below, we prove that the two local treatment effects β_1^1 for the effect of the negative signal and β_1^2 for the effect of the positive feedback are clearly different. We complement the global treatment effect estimates using local linear regressions (LLR) around the thresholds as described by Imbens and Lemieux (2008). The local estimates are sometimes considered as more robust since they do not use data far away from the threshold. In this empirical application, local and global estimates turn out to be very close. In the following section, we detail the econometric results from the estimation of models (1) in Section 4.2 and models (2)–(3) and (4)–(5) in Section 4.3.

4. Empirical results

In Section 4.1, we provide a detailed analysis testing the validity of the approach. In Section 4.2, we present the correlation between enrollment and the signal students receive, next in Section 4.3 we use our identification strategy based on the mathematics grade cutoffs to estimate the causal effect of reviews on university enrollment in Economics at the University of Toulouse. We show that negative signals sharply decrease the registration rate, while positive ones have no effect on high-school students' decisions.

4.1. Testing the validity of the research design

The regression discontinuity design is valid only if the mathematics score distribution is continuous at the passing cutoffs (Lee, 2008; McCrary, 2008). If the distribution is not continuous, it could indicate some sorting of individuals around the threshold. Fig. 1 displays the density of the mathematics score, where dots represent data averages over different bins. The dotted curve represents the fitted values obtained by running a cell-level regression on a cubic polynomial. By graphically comparing the density estimates on each side of the two cutoffs, there are no discontinuities on the graph at the thresholds.

To test formally this graphical observation, we run the procedure developed by McCrary (2008). Table 5 displays the results of the test, and indicates the estimates of the discontinuity in the density of the running variable at the threshold. The test is performed by running kernel local linear regressions of the log of the density separately on both sides of the cutoffs. The estimates are presented for each cutoff in the two different columns. For each test, the table reports the estimated discontinuity in the density function of the running variable at the threshold, its standard error, the t-test, and the sample size. The results

[12] As there are two discontinuities, we could control with a dummy variable for the other threshold in the main equation when using a global polynomial approach, estimating local average treatment effects as in Van der Klaauw (2002). Controlling (or not) for the second discontinuity delivers almost identical results and does not affect the shape of the estimated $h(\cdot)$ function.

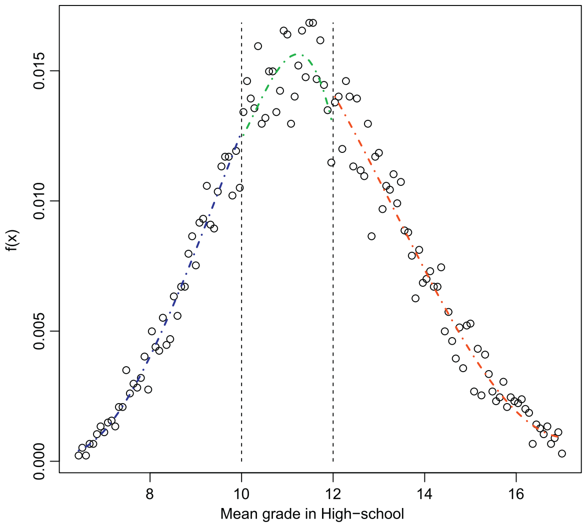

Fig. 1. Density of the Grade in Mathematics. *Notes*: This graph represents the estimated density of the running variable. We test if the distribution is discontinuous at the thresholds. Dots are data averages over different bins while dotted lines are polynomial estimates. The two vertical dotted lines represent the two cutoffs determining the review.

Table 5
McCrary Test of the Discontinuity in the Density of the Running Variable at the Threshold.

	Cutoff 1: Math. Grade=10	Cutoff 2: Math. Grade=12
Coef.	0.1431	0.2193
	(0.178)	(0.204)
t-stat	0.8034	1.0725
Observations	12739	12739

Notes: The table indicates the estimates of the discontinuity at the threshold in the density of the running variable. It is computed as the log difference between the frequency to the right and to the left of the score cutoffs.

show that the log difference between the frequency to the right and to the left of the score cutoffs is not statistically significant.

To complement the analysis of the validity of the research design, we investigate whether or not observable characteristics of students are, on average, the same on both sides of the discontinuity. Table 3 has already shown that observable characteristics in small bins around the thresholds are comparable. Fig. 2 provides additional evidence. It plots an index of baseline characteristics in small bins around the thresholds.[13] The index is the probability of enrollment predicted by baseline characteristics in an OLS regression of enrollment that also controls for polynomials in math score. The baseline characteristics are age, sex, the distance to university, the type of high-school (private or public, general or professional), and a polynomial function of the mathematics score of order three. The left panel displays this index at the first cutoff; the right panel presents the index at the second cutoff. Dotted points are the averaged predicted values in small bins from this regression, and the dotted curves polynomial are estimated on each side of the cutoff. Both panels display no discontinuity around the threshold in the baseline characteristics index.

Finally, we have checked whether or not observable characteristics are locally balanced on either side of the mathematics score cutoffs. If there is non-random sorting, at least part of these characteristics should differ systematically around the cutoffs. To run these tests we have replaced the dependent enrollment variable in Eqs. (2) and (4) with each of the observed baseline characteristics. Table 6 shows the estimated coefficient on the dummy threshold variables for local linear regressions at the optimal bandwidth. The results indicate that observable characteristics are well-balanced on both sides of the mathematics score cutoffs. At the first cutoff, there are two significant discontinuities. There is a difference for the proportion applying to the Department of Management at 10%. At the second threshold, the proportion coming from a major in Economics in high-school is slightly different between both sides of the cutoff. The remaining coefficients show no discontinuities in the baseline characteristics. Overall, from this set of tests we conclude that the validity of the regression design is supported. The next section presents the OLS estimates.

4.2. OLS estimates

Table 7 presents estimates for the effect of the review on enrollment decisions by OLS. The first two columns display the effect of negative feedback, while the following two columns report the effect of positive feedback. In each regression, we control for individual characteristics in order to net out any observable factors affecting enrollment decisions, that may be used by university administrators to determine the reviews. In columns 2 and 4, we add the characteristics of high-schools (general vs technical, public vs private, end of high-school exam graduation rate and distance to university) to control for additional review determinants and high-school quality.

The first column of Table 7 shows no significant correlation between enrollment decision and receiving a negative signal. The proportion of students registering does not change among applicants with a negative review compared to those with the same set of observable characteristics but with positive or neutral feedback. In the second column, when controlling for school characteristics, the estimated effect is still not significant. In columns 3 and 4 there is also no correlation between the positive message and registering in Economics at the University of Toulouse. Overall, the correlation between reviews and enrollment appears to be weak. Caution should be used when interpreting these results as causal relationships, since individuals with lower mathematics score are more likely to receive negative feedback, and at the same time have less chance of studying at the higher education level.

How grades in high-school determine the review applicants receive

University administrators use the high-school mathematics grade to determine the information they send to students. As the reviews are categorical (positive, neutral or negative), they set specific values of the mathematics score to attribute these messages. As demonstrated below, a large part of the variation in reviews come from this single criterion.

Fig. 3 plots the relationship between the review and the high-school grade. In this figure, the left panel represents the proportion of students with a negative signal relative to the mathematics grade in high-school, while the right panel shows the proportion of those attributed with a positive signal relative to the same mathematics grade. The graphs provide raw data means as circles, and the fit from linear regressions are estimated separately on each side of the cutoff. The vertical dotted lines represent the cutoffs. On the left panel, we can see that the probability of getting a negative signal decreases sharply with the grade level, while on the right panel the proportion of applicants with a positive message is an increasing function of the grade. On both graphs, there is a clear and large discontinuity in the relationship between the review and the mathematics numerical score. For the negative signal, the jump is at 10 out of 20, while for the positive one it stands at 12 out of 20. The change in probability on the left graph is around 40 percentage points, while on the right graph it is about 30 percentage points. In Appendix, Figure A.i displays the fit from polynomial regressions in different orders from one to three on the full sample. The results remain identical.

The general patterns presented in Fig. 3 are confirmed in Table 8. This table displays the regression estimates for Eqs. (3) and (5). Panel

[13] Hastings et al. (2013) use a similar strategy.

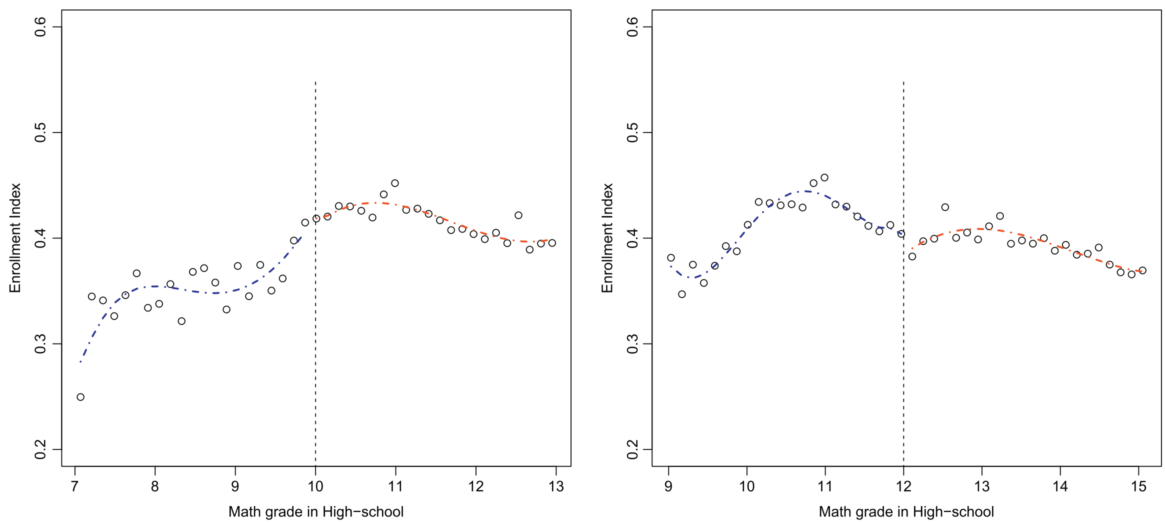

Fig. 2. Impact of Threshold Crossing on Baseline Characteristics Index. *Notes*: These graphs represent the bin-averaged baseline characteristics index. The index is the predicted mean probability of enrollment from a regression of enrollment on an indicator for the cutoff, age, sex, a polynomial of order three on the math grade, an indicator for receiving a scholarship, the distance from high-school to university, the type of high-school (general or professional), and an indicator if high-school is public. Dots are average of predicted values over different bins while dotted lines are polynomial estimates on each side of the threshold. The two vertical dotted lines represent the two cutoffs determining the review.

A shows the estimates of the discontinuity for a negative review, while Panel B focuses on a positive one. On each panel, we provide four estimates with a global polynomial approach; the order of the polynomial ranging from one to four. The panel also includes two estimates with a local linear regression (Imbens and Lemieux, 2008) for two bandwidth choices, the optimal one following Imbens and Kalyanaraman (2012) and half of the optimal bandwidth. As the table indicates, the change in probability at the threshold ranges between 30 and 38 percentage points for the first cutoff (panel A) and between 22 and 29 for the second one in panel B. The difference in probability around the two sides of the cutoffs is highly significant. Moreover, the fit is very good with an R-square around 0.30 in Panel A and 0.32 in Panel B.

4.3. Two-stage least squares estimates

In Table 9, we study whether or not grades in high-school affect university enrollment using the exogenous variation from the review. Panel A details the effect of crossing the first threshold at 10 points on university enrollment probability for different polynomials and two local linear regressions. Panel B focuses on the effect of crossing the second threshold at 12 points on university attendance for the same specifications.

As panel A of the table indicates, there is a significant change in the enrollment probability at the first threshold. University attendance in Economics at the University of Toulouse is from five to six percentage points larger for applicants above the threshold of 10 points in mathematics compared to those just below it. This difference in probability is the reduced-form effect of the policy reform. In relative terms, this represents a 12% change in relative probability (0.05/0.395). In panel B of Table 9, the results are clearly different. There is no significant difference in enrollment probability over the two sides of the second cutoff at 12 points. The estimated coefficient is never statistically different from zero for the four polynomial regressions and the two local linear ones.

Raw data and predicted values from local linear regressions are displayed in Fig. 4, and represents the probability of access to first year undergraduate studies at university relative to the mathematics grade in senior high-school around the cutoffs. The left panel displays results at the first cutoff. The right panel shows the fitted values from the local linear regressions around the second cutoff. These graphs confirm the results from Table 9. The change in probability is apparent on the left panel, while on the right panel there is no visible change in enrollment around the second cutoff. Appendix A.ii presents similar reduced form effects using the full sample and a global polynomial approach.Center Figure 4

Table 10 presents the estimated effect of the signal on university attendance in Economics at the University of Toulouse using the exogenous variation from the grade cutoffs. In each regression, the endogenous review variable is instrumented by two-stage least squares. The excluded instrument is a dummy variable that represents being above a specific threshold. In panel A, we find a strong and negative effect on university attendance decisions for those receiving a negative signal. On average, the proportion of applicants enrolling after receiving a negative signal drops between 12 to 16 percentage points. In relative terms, it is a 30% to 40% change relative to the mean probability to register, which is highly significant in most specifications, even when we use a local linear regression with a very small bandwidth around the threshold at half the optimal size. We find non-significant estimates only when using a polynomial of order four but the value of the estimated coefficient is indeed comparable to lower order polynomials and local linear regressions.

In panel B, we report the relationship between the positive signal and university attendance. Contrary to the results from panel A, the estimated effect is never significant. The point estimate is negative and quite unstable. There is a larger coefficient estimate with a polynomial of order two but the value of the coefficient is at odds with alternative specifications. We interpret this as indicating that this regression picks some of the nonlinearity of the $h(\cdot)$ function. Students around the second threshold are very different from those around the first one. They have higher grades, and thus it is likely that on average they have other more favorable characteristics. From this table we conclude that there is no significant effect of the positive signal on university enrollment in Economics at the University of Toulouse.

For the negative review, IV estimates in Table 10 are larger in absolute value and more significant than OLS estimates presented in Table 7. For the positive signal, IV and OLS estimates are different but become smaller once the review is instrumented. In the former case, IV is negative and strongly significant; in the latter case it is not statistically different from zero. This suggests that feedback does not have an homogeneous effect all along the ability distribution. Negative feedback is highly effective for the individuals with relatively low grades in mathematics and therefore, on average, with a lower academic level. For these students, providing negative messages on their application

Table 6
Estimated Discontinuities in Baseline Characteristics.

	Cutoff 1: Math. grade=10	Cutoff 2: Math grade=12
Age	−0.037	0.010
	(0.055)	(0.054)
Male	0.009	0.037
	(0.028)	(0.032)
French citizenship	−0.008	−0.016
	(0.015)	(0.018)
Scholarship	−0.030	−0.006
	(0.022)	(0.031)
Grade rep. in h-sch	−0.012	0.005
	(0.019)	(0.022)
Applies in Law	−0.041	−0.001
	(0.025)	(0.030)
Applies in Management	−0.048	−0.047
	(0.026)	(0.031)
Major in h-school: Economics	0.037	−0.070
	(0.029)	(0.034)
Major in h-school: Sciences	0.001	0.046
	(0.028)	(0.034)
Major in h-school: Arts	−0.002	0.010
	(0.007)	(0.009)
Major in h-school: Other	−0.035	0.015
	(0.017)	(0.021)
Distance from h-school to university	−0.012	0.000
	(0.013)	(0.019)
General h-school	0.011	−0.037
	(0.016)	(0.019)
Public h-school	0.035	0.002
	(0.024)	(0.028)
Observations	6530	6513

Notes: The table indicates least-square estimates using local linear regressions of discontinuities in the value of covariates at the grade in mathematics thresholds between different reviews. Each coefficient comes from a separate regression. Linear probability models are fitted when the outcome is binary. Robust standard errors are in parentheses.

has a strong deterrent effect. On the other hand, the review process is not effective, or its effect is mitigated by some other factors for students with higher grades in mathematics. On average, these applicants are more often in the upper part of the ability distribution. A simple potential explanation of the difference in results between OLS and IV at the two cutoffs reflects the fact that IV is estimated locally and the effect can be quite heterogeneous, while when considering OLS we measure an average effect smaller in absolute value than the IV estimates. Of course, the two reviews are very different. For the group of students around 10 in mathematics score the message is clearly discouraging, while for those around 12 in mathematics score it is more neutral.

Review effects on other fields of study

As shown in the previous table, receiving a negative signal in a given field strongly decreases the probability of enrollment in this field. In Table 11, we study whether or not receiving a negative signal from the Department of Economics induces students to select other fields of study.[14] The upper panel concentrates on the decision to register in the Department of Management in the same university. Column (1) presents the effect of a negative signal in Economics for students applying in both Economics and Management departments. There is a significant and positive effect of the negative signal in Economics on Management registration decisions. The probability of choosing Management as a field of study increases by 3.9 percentage points, which represents a 10% change in relative terms. This result can be interpreted as reflecting the difference in skill requirements between these two fields of study. Management studies are generally considered to be less demanding in mathematics skills. Students evaluated as weaker in mathematics may select less demanding fields for the skills when they receive a signal that shows that they are not strong in this area. In column (2) we control by the reviews received from this department. The estimates remain identical with a small increase in enrollment probability in Management of four percentage points.[15] In column (3) we restrict further the sample to those applying in Economics, Management and Law departments simultaneously. The coefficient on the negative signal in Economics remains positive but becomes non-significant. The sample is very small, with up to 1500 observations.

The bottom panel of Table 11 focuses on the decision to register in Law as a field of study. The estimated coefficient from the negative feedback in Economics is positive on the choice of Law. It is significant at a p-value of 7.4 percent only. Columns (7) and (8) show that on the subsample of the applicants in the three departments, a negative review from Economics has a positive and significant effect on the choice of Law as an alternative field of study. The probability increases by nearly six percentage points and is significant, representing a change of 15% in relative terms. These results support the interpretation that a negative signal encourages students to select fields of studies that value alternative skills. Hence, students registering in Economics score,

Table 7
Effect of Application Review on University Enrollment: OLS Regressions.

Dep. var. University Enrollment in Economics at Toulouse				
	(1)	(2)	(3)	(4)
Negative Review	−0.009	−0.011		
	(0.009)	(0.009)		
Positive Review			0.009	0.009
			(0.009)	(0.009)
Constant	0.619	0.746	0.611	0.739
	(0.104)	(0.133)	(0.105)	(0.134)
Individual characteristics	Y	Y	Y	Y
h-school characteristics	N	Y	N	Y
Observations	12739	12739	12739	12739
R^2	0.020	0.063	0.020	0.063

Notes: The table reports the OLS estimates for the effect of a negative review in columns (1) and (2) or the effect of a positive review in columns (3) and (4) on university enrollment. Standard errors are in parentheses. Individual characteristics used as control are: age, sex, French citizenship, repeating a year in high-school, situation at the time of application: in high-school, higher education, out of the schooling system. Major in high-school: Economics, Sciences, Arts or Other. Scholarship in high-school. School characteristics used as control are: proportion of senior high-school graduating the year before. Distance between high-school and university and distance squared.

[14] We do not present results for the positive feedback, since as demonstrated above, there is no impact on enrollment in Economics at the University of Toulouse, neither does it affect enrollment in the other fields. Regressions for the positive review become non-significant in any specification.

[15] We lack a credible instrument for the review in Management. In any case, the results for the review in Economics remain similar whether or not we control by the signal in Management. Moreover, fewer students received feedback from this department. We have kept observations without a review as the reference category, controlling for good and bad signals with dummy variables.

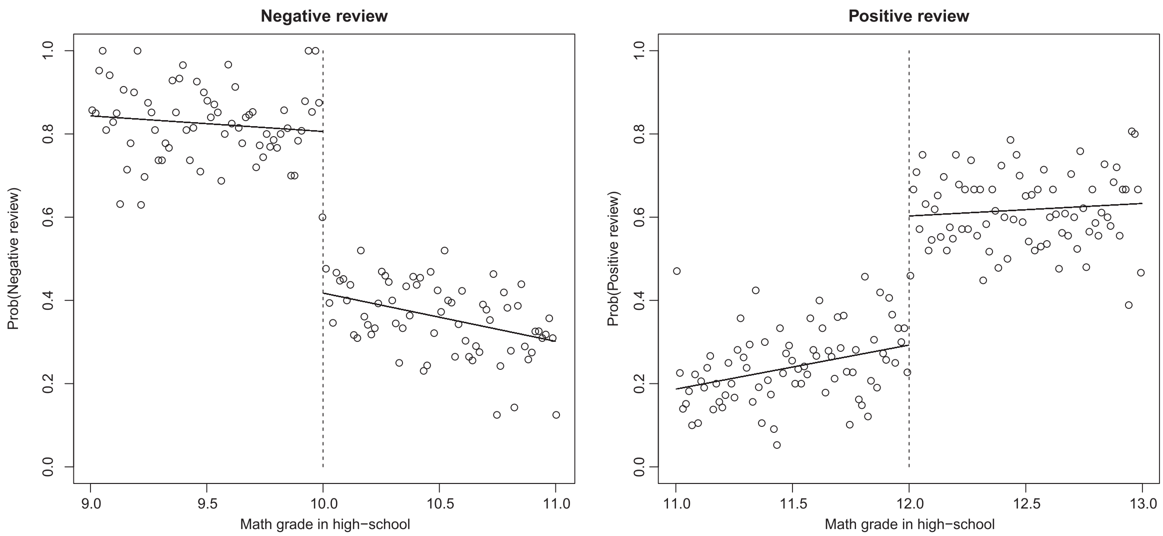

Fig. 3. Mathematics Grade in High-School and Review at University Entrance. *Notes*: Left panel: the figure displays the probability of getting a negative review (versus a positive or a neutral one) relative to the high-school grade in mathematics. Right panel: the figure displays the probability of getting a positive review (versus a neutral or positive one) relative to the high-school mean grade in mathematics. Dots are data averages computed over different bins. The solid lines are the fitted values from local linear regressions estimated separately on both sides of the cutoff. The vertical dotted lines represent the mathematics grade cutoffs.

Table 8
First Stage Regressions of Review Received on Mathematics Grade Cutoffs.

Order of the polynomial	Global polynomial				LLR	
	1	2	3	4	h^*	$h^*/2$
Panel A: Dep. var: Probability of a negative review						
1 {Math Grade ≥ cutoff1}	−0.387	−0.315	−0.309	−0.336	−0.329	−0.329
	(0.015)	(0.019)	(0.024)	(0.029)	(0.021)	(0.030)
Individual and h-school charact.	Y	Y	Y	Y	Y	Y
R^2	0.303	0.305	0.306	0.306	0.243	0.187
Observations	12,739	12,739	12,739	12,739	6555	3474
Panel B: Dep. var: Probability of a positive review						
1{Math Grade ≥ cutoff2}	0.291	0.232	0.227	0.241	0.229	0.263
	(0.012)	(0.016)	(0.020)	(0.024)	(0.021)	(0.031)
Individual and h-school charact.	Y	Y	Y	Y	Y	Y
R^2	0.320	0.322	0.322	0.322	0.179	0.107
Observations	12,739	12,739	12,739	12,739	6770	3592

Notes: The table reports the OLS estimates of the effect of the mathematics grade cutoffs on the probability of receiving a negative review in panel A and on the probability of getting a positive review in panel B. 1{·} is an indicator function taking the value one if the condition is verified, and 0 otherwise. Standard errors are in parentheses. Individual control variables include: age, sex, a polynomial function of the mean mathematics grade in high-school, repeating a year in high-school, situation the year before enrollment: reference: senior high-school year. Major in high-school: reference: major in Economics, French citizenship, scholarship in high-school. School characteristics: high-school graduation-rate: proportion of senior high-school graduating the year before. Distance to university: kilometers between high-school and university (/1000), and distance squared.

on average, 11.65 over 20 in mathematics in high-school, those in Law scored 11.39, while Management students scored 11.19. The mean differences are statistically significant at one percent.

In the following section, we test whether or not these results are robust to alternative sample selections.

4.4. Robustness analysis

Sensitivity analyses of the previous results are presented in Table 12. We present the results for the negative reviews only.[16] In this table, we run 2-SLS regressions, instrumenting the feedback by the first cutoff for the sample of students applying to the department of Economics at the University of Toulouse from 2009 to 2013, as in the previous section. Data are split into more homogeneous subsamples.

In panel A, we divide the initial sample into two time periods, the first from 2009 to 2011, and the second from 2012 to 2013. If the different cohorts of students learn the value of the thresholds in determining the signal from the experience of older cohorts this could affect our results, inducing students to manipulate their academic grade in order to obtain a positive review. Two main results become apparent. First, the estimated effects are comparable to the main estimates from Table 10 with a decrease in enrollment of the same magnitude for students receiving a negative signal. However, due to the smaller sample size, standard errors are large and many coefficients are no longer significant. Second, the estimated effect is comparable over the two time periods with a decrease of 19.6 percentage points in 2009–2011 and 14.8 percentage points in 2012–2013 (representing between 37% and 49% relative to the mean probability) using the local linear regressions results. From this panel, we conclude that there are no differences in time periods.

In panel B, we divide the sample according to the high-school

[16] The same exercise has been run for the positive review, but no significant effect for any subsample has been found.

Table 9
Reduced Form Regressions of University Enrollment on the Mathematics Grade Cutoffs.

Dep. var: University Enrollment in Economics at Toulouse						
Order of the polynomial	Global Polynomial				LLR	
	1	2	3	4	h*	h*/2
Panel A: First cutoff Math. grade=10						
1{Math Grade ≥ cutoff1}	0.059	0.037	0.062	0.049	0.050	0.054
	(0.017)	(0.022)	(0.027)	(0.033)	(0.023)	(0.032)
Individual and h-school charact.	Y	Y	Y	Y	Y	Y
R^2	0.069	0.069	0.070	0.070	0.091	0.095
Observations	12,739	12,739	12,739	12,739	6555	3474
Panel B: Second cutoff Math grade=12						
1{Math Grade ≥ cutoff2}	−0.015	−0.033	−0.020	−0.011	−0.010	−0.014
	(0.014)	(0.020)	(0.025)	(0.030)	(0.023)	(0.032)
Individual and h-school charact.	Y	Y	Y	Y	Y	Y
R^2	0.068	0.069	0.070	0.070	0.061	0.070
Observations	12,739	12,739	12,739	12,739	6770	3592

Notes: The table reports the OLS estimates of the mathematics grade cutoffs on university enrollment. The first four columns display estimates on the full sample approximating the $h(\cdot)$ function with a polynomial function. The last two columns display local estimates around the threshold with a Local Linear Regression (LLR). $1\{\cdot\}$ is an indicator function taking the value one if the condition is verified, and 0 otherwise. Standard errors are in parentheses. Individual control variables include: age, sex, a polynomial function of the mean mathematics grade in high-school, repeating a year in high-school, situation the year before enrollment: reference: senior high-school year. Major in high-school: reference: major in Economics, French citizenship, scholarship in high-school. School characteristics: high-school graduation-rate: proportion of senior high-school graduating the year before. Distance to university: kilometers between high-school and university (/1000), and distance squared.

major. The first sub-sample includes students with a major in Economics, the second with a major in Arts or Sciences. If the original assumption of the policy reform is correct, stating that non-informed students should benefit from more information on post-secondary education, the estimated effect of the review should be stronger for students with a major in Arts or Sciences. They are probably less well informed on the requirements to succeed in Economics at university than students with a high-school major in Economics. 2-SLS estimates confirm this intuition. The point estimates are, on average, twice as large for the second group, but due to the small sample size the difference is not statistically significant. In panel C, we split the sample according to the place of residence. The first subsample concentrates on students living in the regional district of the university. One could expect that it is more costly to acquire information for students living further away from university. The estimated effect should be larger for this second group of students. The results partly confirm this intuition since the point estimates are larger among those living further away but they are not statistically different across the two groups. Finally in panel D, we restrict the sample to two different subsamples. In the upper part, we focus on the students applying only to the Department of Economics and not to any other department. These students are more affected by the reform, since the point estimate is larger. In the lower part of panel D, we consider students coming from more disadvantaged backgrounds receiving some form of scholarship while they are attending high-school. A recent literature (see for example Hoxby and Avery, 2013) has demonstrated that high-ability, low-income students are those who would benefit most from an information intervention. The estimated coefficient is indeed large, but is not significantly different from the main estimates.

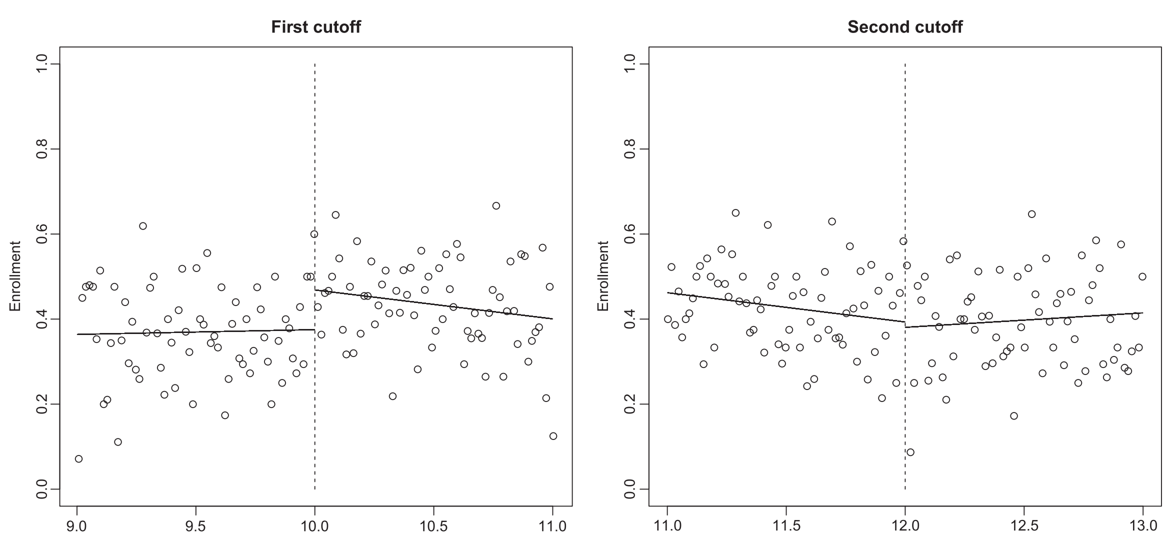

Fig. 4. University Enrollment and Mathematics Grade in High-school. *Notes*: the figures display the probability to enroll relative to the grade in mathematics in high-school. Circles represent the average fraction of applicants enrolling per interval of grade in mathematics. The solid lines are the fitted values from local linear regressions estimated separately on both sides of the cutoff. The vertical dotted lines represent the mathematics grade cutoffs.

Table 10
Effect of Application Review on University Enrollment: 2SLS Regressions.

Dependent var: University Enrollment in Economics at Toulouse						
Order of the polynomial	Global Polynomial				LLR	
	1	2	3	4	h*	h*/2
Panel A: Effect of receiving a negative review						
Negative Review	−0.153	−0.119	−0.201	−0.146	−0.151	−0.163
	(0.043)	(0.071)	(0.090)	(0.098)	(0.071)	(0.098)
Individual and h-school charact.	Y	Y	Y	Y	Y	Y
Observations	12739	12739	12739	12739	6555	3474
Panel B: Effect of receiving a positive review						
Positive Review	−0.052	−0.142	−0.087	−0.047	−0.043	−0.052
	(0.050)	(0.087)	(0.109)	(0.123)	(0.100)	(0.122)
Individual and h-school charact.	Y	Y	Y	Y	Y	Y
Observations	12739	12739	12739	12739	6770	3592

Notes: The table reports the 2-SLS estimates of the mathematics grade cutoffs on university enrollment. The first four columns display estimates on the full sample approximating the $h(\cdot)$ function with a polynomial function. The last two columns display local estimates around the threshold with a Local Linear Regression (LLR). $1\{\cdot\}$ is an indicator function taking the value one if the condition is verified, and 0 otherwise. Standard errors in parentheses. Individual control variables include: age, sex, a polynomial function of the mean mathematics grade in high-school, repeating a year in high-school, situation the year before enrollment: reference: senior high-school year. Major in high-school: reference: major in Economics, French citizenship, scholarship in high-school. School characteristics: high-school graduation-rate: proportion of senior high-school graduating the year before. Distance to university: kilometers between high-school and University (/1000), and distance squared.

4.5. Falsification tests

In this section, we present two falsification tests. First, we use data on a cohort of students at the Department of Economics of the University of Toulouse in 2008. These individuals used the APB website to select which university to register with. They had not been affected by *Active Orientation* policy, since it was implemented in 2009. Therefore, in the APB dataset, we observe the students' grades in high-school, and can compute their enrollment status with the University internal records. Second, we use data on students applying to the Departments of Law and Management at the University of Toulouse during the 2009–2013 period. As explained above, these students are not subjected to the cutoffs in the mathematics grade since these departments chose alternative criteria using high-school major to allocate feedback. More importantly, very few of these students received a review as they had to specifically request one, and most of them did not in fact do so.[17]

In Table 13, we report the regression of university enrollment on the dummy variables for each cutoff for these two samples. In panel A, we report results for the cohort of students in 2008. In panel B, we display the results for students applying to study in Law or Management. In both panels, these regressions represent reduced form effects in a pre-policy period for the first sample and reduced form effects on non-treated observations for the second sample. There are no first stage regressions associated with these samples since none of them received a review based on their grades in mathematics in high-school from the Department of Economics. For these samples, if the reduced form effect is in fact significant, this would invalidate our identifying assumption that the discontinuity in enrollment at the threshold is due to the review, since the difference at the threshold would not be due to the signal but to other confounding factors. In Table 13, panels A and B are divided into two parts. The left side displays the effect on university enrollment at the first cutoff, while the right side presents the effect at the second cutoff.

[17] In this sample we retained the students receiving a review from the Law or Management departments, as excluding them does not change the results.

Table 11
Effect of a Negative Review in Economics on Alternative Outcomes.

Dependent var: Enrollment in Management at Toulouse				
Apply in Economics and in	Manag.	Manag.	Manag. & Law	Manag. & Law
	(1)	(2)	(3)	(4)
Negative Review in Economics	0.039	0.040	0.025	0.025
	(0.012)	(0.012)	(0.019)	(0.019)
Review in Management	N	Y	N	Y
Review in Law	N	N	N	Y
Individual and h-school charact.	Y	Y	Y	Y
Observations	3849	3849	1457	1457
R^2	0.016	0.016	0.022	0.024
Dependent var: Enrollment in Law at Toulouse				
Apply in Economics and in	Law	Law	Law & Manag.	Law & Manag.
	(5)	(6)	(7)	(8)
Negative Review in Economics	0.026	0.026	0.057	0.059
	(0.015)	(0.015)	(0.021)	(0.021)
Review in Law	Y	N	Y	Y
Review in Management	N	N	N	Y
Individual and h-school charact.	Y	Y	Y	Y
Observations	3339	3339	1457	1457
R^2	0.034	0.035	0.040	0.042

Notes: The table reports the 2-SLS estimates of the negative review on fields enrollment. The upper panel displays estimates for registration in Management, while the bottom panel concentrates on registration in Law. Standard errors are in parentheses. Individual control variables include: age, sex, a polynomial function of the mean math grade in high-school, repeating a year in high-school. Situation the year before enrollment: reference: senior high-school year. Major in high-school: reference: major in Economics, French citizenship, scholarship in high-school. School characteristics: high-school graduation-rate: proportion of senior high-school graduating the year before. Distance to university: kilometers between high-school and university (/1000 km), and distance squared.

The results from these regressions show no statistically significant effect. There is no difference in enrollment probability across the two sides of the thresholds for either of the two samples. Moreover, for the sample of applicants in Law or Management, in panel B, the results are very precisely estimated, since this is a very large sample with 34,655 observations. These results hold for both the global polynomial regressions and the local linear ones. However, for the local linear regressions, it is not possible to compute any optimal bandwidth since there is no treatment. In this table, we use the same bandwidth as used for the main sample at 1.83 for the first cutoff and 1.56 for the second cutoff. In order to test for the sensitivity of this choice, we run local linear regressions with bandwidths ranging from 0.4 to 2, increasing the size of the bandwidth each 0.01 mathematics grade point. In the Appendix, Figure A (iii) displays the estimated reduced form effects and their standard errors for the positive and negative reviews, and for the two samples of pre-program and non-treated observations. None of the estimated coefficients are statistically different from zero with a 95% confidence interval.

We interpret these results as evidence that the estimates of the reduced form effect presented in Table 9 measure the causal impact of the review on university enrollment. The difference in enrollment probability during the reform period between the two sides of the first cutoff is only driven by the review, not by any other factor. Otherwise,

Table 12
2SLS Regressions: Robustness Analysis.

Dependent var: University Enrollment in Economics at Toulouse					
Order of the polynomial	Global Polynomial				LLR
	1	2	3	4	h*
Panel A: Differences by time periods					
Sample 1: Years 2009–2011	−0.184	−0.144	−0.157	−0.158	−0.196
	(0.049)	(0.081)	(0.094)	(0.104)	(0.075)
Observations	7837	7837	7837	7837	4312
?Sample 2: Years 2012–2013?	−0.214	−0.132	−0.430	−0.192	−0.148
	(0.094)	(0.183)	(0.294)	(0.314)	(0.204)
Observations	4902	4902	4902	4902	2243
Panel B: Differences by major in high-school					
Sample 1: Major in Economics	-0.118	0.009	−0.108	−0.146	−0.036
	(0.068)	(0.112)	(0.134)	(0.157)	(0.105)
Observations	6320	6320	6320	6320	3087
Sample 2: Major in Arts or Sciences	−0.229	−0.241	−0.339	−0.276	−0.295
	(0.059)	(0.100)	(0.127)	(0.143)	(0.102)
Observations	6419	6419	6419	6419	3468
Panel C: Differences by place of residence					
Sample 1: Midi-Pyrénées region	−0.148	−0.121	−0.214	−0.165	−0.171
	(0.053)	(0.086)	(0.104)	(0.118)	(0.087)
Observations	8855	8855	8855	8855	4585
Sample 2: Other regions	−0.236	−0.136	−0.152	−0.129	−0.180
	(0.074)	(0.126)	(0.166)	(0.191)	(0.124)
Observations	3884	3884	3884	3884	1970
Panel D: Subsamples					
Apply only to the Econ dept.	−0.213	−0.181	−0.283	−0.143	−0.230
	(0.057)	(0.096)	(0.124)	(0.127)	(0.096)
Observations	7008	7008	7008	7008	3500
Scholarship in h-school	−0.201	−0.303	−0.365	−0.534	−0.251
	(0.096)	(0.154)	(0.181)	(0.218)	(0.150)
Observations	2111	2111	2111	2111	1161

Notes: The table reports the 2-SLS estimates of the negative review on university enrollment. The first four columns display estimates on the full sample approximating the $h(\cdot)$ function with a polynomial. The last two columns display local estimates around the threshold with a Local Linear Regression. $1\{\cdot\}$ is an indicator function taking the value one if the condition is verified, and 0 otherwise. Standard errors are in parentheses. Individual control variables include: age, sex, a polynomial function of the mean mathematics grade in high-school, repeating a year in high-school. Situation the year before enrollment: reference: senior high-school year. Major in high-school: reference: major in Economics, French citizenship, scholarship in high-school. School characteristics: high-school graduation-rate: proportion of senior high-school graduating the year before. Distance to university: kilometers between high-school and university (/1000 Km), and distance squared.

we would still observe this difference in enrollment probability across the threshold, even for individuals not affected by the reform. As Table 13, shows this is not the case. We conclude from this table that our identifying assumption is not contradicted by this quasi-experimental approach. A note of caution is necessary here. In the first falsification test, the sample from 2008 includes a single cohort of individuals, and is therefore smaller than the main sample which includes five cohorts from 2009 to 2013. The difference in results could be due to the difference in sample sizes. We cannot extend this pre-policy sample to earlier years since the APB data did not exist before 2008. The second sample of non-treated observations is much larger than the main sample. In any case, the point estimates in Table 13 are much smaller in absolute value than those of Table 9.

4.6. *Who is affected by the reform?*

Finally, in this section, we present statistical evidence on the characteristics of those students whose choice is affected by the new information. We will call these the compliers (Angrist et al., 1996). We call W_{1i} the dummy variable equal to 1, if individual i receives a negative signal with a mathematics score lower than 10 points, and W_{0i} the dummy variable equal to 1 with a negative review while her grade is above 10 points. The compliers group is defined by $W_{1i} = 1$ and $W_{i0} = 0$. We can compute different statistics on these individuals whose choices are changed by the instrument. In Table 14, panel A indicates their relative importance. The size of the compliers group, measured by the first stage regression, shows that they represent around one third of the students with 18% of those receiving a negative review. Panel B displays their mean characteristics relative to the full population; there are slightly more female students among the compliers than in the full sample, they are more likely to receive a scholarship, and they are less likely to come from a Science major in high-school. Panel C measures their counterfactual mean enrollment probability (Abadie, 2003). Let us denote y_{1i} the counterfactual enrollment decision of individual i if she receives a negative message, and y_{0i} her counterfactual choice when she does not. As the table indicates, there is a 5.26 percentage points difference in probability in their enrollment decisions for the compliers if they receive a negative review or if they do not receive one. This points to a large effect of the AO policy for this group.

5. Discussion and conclusion

In this paper, we use a French administrative database to test whether or not feedback provided by experts changes higher education choices made by students. We use the discontinuity existing between the signal sent to students and their high-school grades in order to identify the causal effect of the reviews on students' decisions to enroll in Economics at the University of Toulouse. We show that for students with strong high-school academic records, information transmitted by a university does not change their enrollment choices. For the students with a lower high-school academic level however, negative feedback greatly influences their behavior, and they may then select a field valuing different skills. The effect is larger for those with a high-school major differing from the field they have considered for their post-secondary studies and for those living further away from university. For both groups, expert-provided information is a key determinant in their enrollment choices. Overall, these results indicate that students change their field of study decisions when signals deliver negative information, while positive signals do not affect their enrollment choices.

To interpret these results, we should consider the determinants of the students' decisions. Students with lower self-confidence may more easily accept the advice of university experts. Individuals with a strong belief in their own abilities may more often disregard external information. Empirical evidence suggests that the more academically unprepared students are, the more likely they are to have lower self-confidence (Heckman et al., 2006), or to have a less accurate idea of their abilities (Stinebrickner and Stinebrickner, 2012). Following these lines, weaker students may act rationally following the signal, and change their the field of study. Alternatively, weaker students may benefit more from external information if they are less well-informed on their schooling opportunities (Borghans et al., 2013; Scott-Clayton, 2012). In this paper, we do not distinguish incomplete information about individual skills from the incomplete information about higher education. From a policy perspective, both channels lead to the development of public support for access to post-secondary education.

Yet, our analysis does not provide a full picture of the policy effects

Table 13
Falsification Tests: Reduced-Form Regressions.

Dep. Variable: University Enrollment in Economics at Toulouse										
Order of the polynomial	Negative Review					Positive Review				
	Global Polynomial				LLR	Global Polynomial				LLR
	1	2	3	4	h*	1	2	3	4	h*
Panel A: Sample 1: Pre-program data										
1{Math Grade ≥ cutoff}	0.060	−0.008	−0.032	−0.048	−0.001	0.043	−0.042	−0.050	0.000	−0.018
	(0.041)	(0.060)	(0.079)	(0.100)	(0.063)	(0.036)	(0.053)	(0.069)	(0.086)	(0.059)
R^2	0.057	0.059	0.060	0.060	0.065	0.057	0.060	0.060	0.060	0.056
Observations	2072	2072	2072	2072	961	2072	2072	2072	2072	1088
Panel B: Sample 2: Applicants in other departments										
1{Math Grade ≥ cutoff}	0.007	0.019	0.025	0.041	0.018	−0.015	−0.009	−0.032	−0.020	−0.017
	(0.009)	(0.013)	(0.016)	(0.019)	(0.014)	(0.009)	(0.013)	(0.016)	(0.019)	(0.014)
R^2	0.069	0.069	0.069	0.069	0.074	0.069	0.069	0.069	0.070	0.071
Observations	34,655	34,655	34,655	34,655	17,544	34,655	34,655	34,655	34,655	16,894

Notes: The table reports the OLS estimates of the mathematics grade cutoffs on university enrollment. The first four columns display estimates on the full sample approximating the $h(\cdot)$ function with a polynomial function. The last column displays local estimates around the threshold with a Local Linear Regression. $1\{\cdot\}$ is an indicator function taking the value one if the condition is verified, and 0 otherwise. Standard errors are in parentheses. Individual control variables include: age, sex, a polynomial function of the mean mathematics grade in high-school, repeating a year in high-school, situation the year before enrollment: reference: senior high-school year. Major in high-school: reference: major in Economics, French citizenship, scholarship in high-school. School characteristics: high-school graduation-rate: proportion of senior high-school graduating the year before. Distance to university: kilometers between high-school and university (/1000), and distance squared.

Table 14
Characteristics of the Compliers.

A. Importance of the complier-group		
Size of the complier-group	$P(W_{1i} > W_{0i})$	0.336
Prop. of treated that are compliers	$P(W_{1i} > W_{0i}/W_i = 1)$	0.185
B. Complier-characteristics ratios		
Male	$P(x_{1i} = 1/W_{1i} > W_{0i})/P(x_{1i} = 1)$	0.903
Scholarship		1.141
Major in high-school: Economics		1.032
Major in high-school: Science		0.854
Major in high-school: Arts		1.090
Public high-school		0.926
C. Counterfactual Enrollment Probability		
Conditional on a negative message	$E(y_1/W_{1i} > W_{0i})$	0.3661
Conditional on a neutral/positive message	$E(y_0/W_{1i} > W_{0i})$	0.4187

Notes: The table reports the characteristics of the compliers' group. W_i: Receiving a negative feedback, x_{1i}: Dummy variable for predetermined individual characteristics.

for different reasons. We do not observe student choices when they do not register in this institution. Admittedly, this case is not straightforward to interpret since students can drop out of higher education or they can select to enroll in another institution: these scenarios have are very different outcomes. Indeed, it would be interesting to know if this policy has any impact on the completion of a degree. Students who receive negative feedback may feel discouraged and decide to drop out, which would likely diminish the benefits of such a system. Admittedly, a long term impact evaluation of the policy is necessary, while our analysis focuses only on the first order effect of the policy on enrollment choices. Still, the results of this experiment are in line with a large body of existing literature (Hastings and Weinstein, 2008; Avery, 2010; Bettinger et al., 2012; Oreopoulos and Dunn, 2013) who document that counseling students on their choice of subject major directly affects their educational choices.

In this article, we study enrollment decisions within a single institution. Alternative outcomes could have been investigated. Testing whether or not this policy affects enrollment choices at any university or in any Economics department would provide a broader picture of the impact of the reform. Due to data constraints, we do not observe the achievement of students in our dataset. A full evaluation of the AO policy remains to be completed.

From an international perspective, such results have important implications. This policy represents a simple and cost effective tool, allowing access to information on higher education. It is an inexpensive method since the full procedure is computer-based, and information is transmitted automatically by email. Moreover, as signals depend on high-school grades, it could be quasi-automatically implemented with very few university officers required to manage the system. Our analysis is restricted to the simple empirical evidence of the direct effect of the AO policy, while a complete cost-benefit analysis of the policy remains an important exercise for future study.

Appendix A. Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.labeco.2016.12.002.

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