Returns to Education Quality for Low-Skilled Students: Evidence from a Discontinuity*

Serena Canaan† and Pierre Mouganie‡

This Version: November 2016

Abstract

This paper studies the labor market returns to quality of higher education for low-skilled students. Using a regression discontinuity design, we compare students who marginally pass and marginally fail the French high school exit exam from the first attempt. Threshold crossing leads to an improvement in the quality, but has no effect on the quantity of higher education pursued. Specifically, students who marginally pass are more likely to enroll in STEM majors and postsecondary institutions with better peers. Marginally passing also increases earnings by 12.5 percent at the age of 27 to 29. Our findings show that low-skilled students experience large gains from having the opportunity to access higher quality postsecondary education.

JEL Classification: H52, I21, I28, J24

Keywords: Quality of education, returns to education, regression discontinuity design

*This paper has been previously circulated under the title "Quality of Higher Education and Earnings: Regression Discontinuity Evidence from the French Baccalaureate". We would like to thank Kelly Bedard, Olivier Deschênes, Mark Hoekstra, Scott Imberman, Peter Kuhn, Jason Lindo, Shelly Lundberg, Paco Martorell, Jonathan Meer, Steven Puller and Heather Royer for their invaluable comments and suggestions. We also thank seminar participants at the 6th Annual Southern California Conference in Applied Microeconomics, the annual European Economic Association (EEA) meetings, the IZA European Summer School in Labor Economics and the Applied-Micro brown bag seminar at Texas A&M University for helpful comments and discussions. Finally, we would like to thank the staff at the "Centre Maurice Halbwachs" for providing us with the data. All errors are our own.

†Address: American University of Beirut, Department of Economics, Ada Dodge Hall Room 243, Riad El-Solh/Beirut 1107 2020, Lebanon, e-mail: sc24@aub.edu.lb

‡Address: American University of Beirut, Department of Economics, Ada Dodge Hall Room 239, Riad El-Solh/Beirut 1107 2020, Lebanon, e-mail: pm10@aub.edu.lb

1 Introduction

Over the past few decades, access to higher education has become more prevalent. In the United States, the percentage of 18 to 24 year-olds enrolled in postsecondary institutions increased from 25.7% in 1970 to 41% in 2012 (U.S Department of Commerce, 2013). With college becoming more attainable, an increasingly important issue is how the type of postsecondary education pursued affects students' labor market outcomes. Addressing this question is essential to inform policy and student choice as virtually every college student has to decide on a specific institution and field of study to enroll in. Furthermore, governments have been increasingly investing in STEM fields, as they are perceived to be the basis for innovation. For example, the United States' budget for the fiscal year 2016 allocates over $3 billion for STEM education programs (White House, 2015).

As discussed further below, recent studies document large returns to pursuing certain fields of study and attending more selective universities. Yet, it is unclear whether students who are at the low end of the skill distribution can benefit from an increase in quality of higher education. This is important as the returns can be quite heterogeneous and may be driven by high-skilled students (Andrews, Li and Lovenheim, 2016). The purpose of this paper is to fill this gap in the literature by studying the labor market returns to quality of postsecondary education for low-skilled students. In our context, quality of higher education refers to both the quality of institution attended and field of study pursued—where institution quality is proxied by peer ability. This matters as students in most settings around the world must simultaneously select an institution and a field of study.

To investigate this question, we exploit the fact that students in France are required to sit for a series of national written exams in their last year of high school. Those who pass the "high stakes" exam are awarded the Baccalauréat Général or the General Baccalaureate, a degree which is required to graduate from high school and enroll in a postsecondary institution. Students are generally given two attempts to pass the exam within the same year. However, the standards for passing are significantly higher in the first round. We use a regression discontinuity design, which leverages the fact that barely passing versus barely failing the exam on the first attempt leads to a significant increase in quality of higher education—without affecting the quantity of education pursued. Our RD design allows us to overcome selection bias arising from the fact that postsecondary educational choices are likely correlated with unobservable factors that may also affect future earnings, such as ability and motivation.

Using administrative test score data linked to three detailed surveys, we find that marginally passing on the first attempt results in a significant increase in the quality of higher education pursued. Specifically, threshold crossing leads to an improvement in the average peer quality that students are exposed to in college, on the order of approximately 13 to 14 percent of a standard deviation in Baccalaureate scores. We also find that marginally passing increases the likelihood of STEM enrollment at a postsecondary institution by 19 to 23 percentage points. As detailed in section 2.2, this increase in quality is most likely driven by universities' policies of enrolling students on a "first come, first serve" basis, as well as to students potentially becoming discouraged after failing the first exam attempt.

We then explore the effects of this variation in education quality on labor market outcomes. Results indicate that marginally passing leads to a 12.5 percent increase in earnings at the age of 27 to 29, with no significant employment effects. Importantly, we rule out other possible channels through which threshold crossing may affect earnings. We find no significant effect on years of postsecondary education and on the probability of enrolling or graduating from a postsecondary institution. Moreover, we find no discontinuity in the likelihood of ever obtaining the Baccalaureate degree, i.e. graduating from high school. This rules out the direct signaling value of the General Baccalaureate degree as a potential channel that could be driving the documented increase in earnings.[1] Accordingly, we conclude that having the option to access higher quality postsecondary education—defined along two separate dimensions—raises earnings by 12.5 percent for low-skilled students.

Our paper is closest to an emerging body of literature that uses regression discontinuity designs to identify the economic returns to higher education quality.[2] Previous studies uncover a significant earnings premium from attending the most selective pubic university in a U.S. state (Hoekstra, 2009) and the most selective universities in Colombia (Saavedra, 2008). Other studies examine the gains from accessing 4-year public universities versus 2-year community colleges in the U.S. (Zimmerman, 2014; Goodman, Hurwitz and Smith, forthcoming). Recent papers also document large returns to different fields of study (Hastings, Neilson and Zimmerman, 2013; Kirkebøen, Leuven and Mogstad, 2016).

We add to this literature in several ways. First, we focus on the labor market returns for low-skilled students who do not attend the most selective institutions. While this focus is similar to that of Zimmerman (2014), the main difference is that Zimmerman (2014) estimates returns to different sectors (4-year versus 2-year colleges) that ultimately lead to variation in the number of years spent in postsecondary education. In contrast, in our

[1]Specifically, we rule out the signaling value of eventually obtaining the Baccalaureate diploma, but not necessarily the signaling value of the timing of degree receipt.

[2]Our study is also linked to previous work on the returns to quality of higher education, most of which focused on high-skilled students who attend the most selective institutions. For example, see Brewer, Eide and Ehrenberg (1999), Dale and Krueger (2002), Black and Smith (2006), and Hamermesh and Donald (2008).

study the time to completion for degrees does not vary across institutions because marginal students at the cutoff are moving within the traditional university sector. As a result, the earnings gains in our study are driven by differences in peer quality and access to STEM degrees, holding quantity of education constant.

Second, we examine the labor market returns to quality of postsecondary education using an entire national university system. This contrasts with previous studies, which usually focus on the labor market returns to attending a single institution or a subset of institutions within a country (Hoekstra, 2009; Saavedra, 2008; Zimmerman, 2014).[3] A potential drawback of some of these studies is that they cannot observe the postsecondary educational outcomes for students who are not enrolled at that specific institution. One advantage of our data is that they include the institution and field of study for every student in our sample, allowing for a clear interpretation of the counterfactual.

In examining the returns to higher education quality, our study is also related to a literature on the causes and effects of academic"mismatch". Recent papers highlight a growing concern in the education sector whereby high-skilled students from low-income families tend to "undermatch", i.e. select universities where the average peer ability is lower than their own (Hoxby and Avery, 2014). In our case, students around the threshold are low-skilled and enroll in universities where the average peer ability is higher than their own, i.e. "overmatch". In that sense, we document significant labor market returns to "overmatching". This finding complements the Goodman et al. (forthcoming) study, which documents gains from "overmatching" for low-skilled students in the form of increased BA completion rates.

Section two presents detailed information on the French educational setting. Section three reviews our identification strategy. Section four describes our data. Section five presents the main empirical results as well as robustness checks. Finally, in section six, we discuss our results and we conclude in section seven.

2 Institutional Background

2.1 The General Baccalaureate

The Baccalauréat Général (or the General Baccalaureate) is a French national degree awarded to students in their last year of high school. It marks the completion of secondary education and is also required for enrollment in postsecondary institutions. Within the General Baccalaureate, students can choose one of three specializations: economics & sociology,

[3]Goodman et al. (forthcoming) also focus on low skilled students and have the advantage of being able to track all students within the Georgia university system. However, the main outcome of interest in their paper is BA completion rates.

literature or sciences. Specializations differ in terms of the subject matter that the curricula focus on. For instance, students specializing in literature have a curriculum predominately focused on subjects such as French literature and philosophy even though they are still required to take all subjects. The percentage of students awarded the General Baccalaureate increased from 67.2% in 1975 to 80.3% in 2002 and 92% in 2013.

In order to be awarded the degree, students must pass a series of national written exams. The exams cover all subjects taken throughout the last academic year and are common to all students within the same specialization. Written and oral exams for the French literature section of the Baccalaureate are administered a year prior to all other tests. Each subject has a different weight depending on student specialization. The weighted average of all subjects is then used to compute the final score on the Baccalaureate exam.

After the exams are administered, they are randomly assigned to preselected secondary school teachers for grading. Two committees supervise the process to guarantee uniform grading. Juries across France then meet to decide whether a degree is conferred. Importantly, students' identities remain anonymous throughout this whole process. In order to be awarded the degree, a student's total weighted score must be greater than or equal to 10 out of 20 possible points. The student is also granted an *Assez Bien* (fairly good), *Bien* (good) or *Très Bien* (very good) distinction if he/she scores above a mark of 12, 14 and 16 respectively.

Students generally have two attempts to pass the exam in a given year. A student who fails the initial attempt can opt to retake the exam in the second round, conditional on scoring at least 8 points on the first try. With a total score below 8, the student has to wait an additional year to retake the exam. Students select two failing subjects to be retested on in the second round of exams. As a result, they vary from one student to the other. The new grades on these two subjects are then added back to the remaining grades from the first round to calculate a new total score. The student is granted the degree if his/her new average score is greater than or equal to 10. The Baccalaureate degree obtained in either attempt is the same. However, the second round of exams are often criticized for being unchallenging and unreliable. This is mainly because they are conducted orally and administered by only one teacher. This allows students to negotiate a passing score with their respective teacher (Buchaillat et al., 2011).

2.2 The higher education system in France

There are four main academic college sectors that a student has access to upon graduating from high school. Students can apply to the "Grandes Ecoles", vocational institutes, vocational degrees in lyceums, and universities. Back in 2002, there was no national centralized system that students could use to apply to higher education establishments.[4] Further, students applied to an institution and major simultaneously.

The "Grandes Ecoles" are the most prestigious and selective post-baccalaureate institutions in France. They offer degrees in a multitude of fields including engineering, business and political sciences. Time to completion for these degrees is usually five years. Students can enroll in the "Grandes Ecoles" either immediately after high school or after attending two years of preparatory classes in lyceums. Admission to both these routes is based on students' academic results in the last two years of secondary education, their scores on the French literature portion of the baccalaureate exams and tests that are specific to each institution. Admissions decisions are made before students sit for the first round of baccalaureate exams. Further, the low-skilled students that we look at do not attend these institutions.

There are two types of vocational paths. Students can apply to vocational institutes (*Institut Universitaire de Technologie* or *IUT*) where they obtain a DUT (*Diplôme Universitaire de Technologie*) after two years or a professional bachelors' degree after three years. Another option is to pursue a two-year BTS (*Brevet de Technicien Supérieur*) degree at lyceums. Admissions to vocational degrees are considered competitive. Students are generally admitted based on their academic results in the last two years of secondary education or upon obtaining a distinction on the baccalaureate exams.

Around 66% of students in our marginal sample, who choose to pursue postsecondary education, do so by attending the university sector (or *universités*). The majority of universities in France are public. Time to completion for most bachelor's degrees is three years.[5] There are two types of universities: multidisciplinary and specialized. Specialized universities usually focus on majors that fall under one of three broad areas of study: law, business and economics; sciences and health; humanities, arts and social sciences. Multidisciplinary universities, which constitute over half of public universities, offer a wide variety of majors. Some regions, have either specialized or multidisciplinary universities. Others, have both types of universities.[6] Specialized and multidisciplinary universities offer similar bachelor's

---

[4] Although no national centralized system was in place, students from the Île-de-France region applied to higher education establishments via a centralized system called RAVEL. (Source: `http://www.lemonde.fr/orientation-scolaire/article/2012/03/08/apb-ou-le-passage-oblige-pour-acceder-au-superieur_1652943_1473696.html`)

[5] Students received an intermediate degree, the "Diplôme d'études universitaires générales" (or DEUG), after two years in universities. The "Licence" (or the equivalent of the bachelor's degree) is awarded after an extra year. Starting 2003, the DEUG was gradually phased out. However, only 13 universities had partially eliminated the degree by 2003. We are not too concerned about the effects of this reform on our sample as more than 90% of the students who failed the first round of the 2002 exams had obtained their Baccalaureate degree by 2003.

Source: `http://www.mesr.public.lu/enssup/dossiers/bologne/processus_bologne.pdf`

[6] For the academic year 2002-2003, around 45% of university students were located in regions with both types of universities, 33% in regions with multidisciplinary universities only and 22% in regions with spe-

degrees. In other words, a student who pursues a certain major at a specialized university will eventually be awarded the same diploma as a student who graduates from that same major at a multidisciplinary university. Time to completion for degrees also does not vary across universities. The only observable difference between the two types of universities is that some focus on specific fields of study while others provide a more comprehensive selection of majors. Appendix C2 and C3 provide further overview of the traditional and vocational higher education systems respectively.

As we document in section 5, first time passing leads to variation in quality but not quantity of postsecondary education pursued. Several features of the French university system lend themselves to this result. First, by law, the only requirement for university admission is to have proof of Baccalaureate degree receipt. However, in practice, universities are capacity constrained and a student can be denied admission to the university and major of his choice. Priority is usually given to students who reside in the same area as the university. Other students are admitted on a first come, first serve basis. Students who pass the first round of the Baccalaureate exam are awarded their degree a week prior to those who pass on the second round. Specifically, for the academic year 2001-2002, the first round exams took place from June 13 to June 20. Students received the results of the first round on July 5. The second round oral exams were administered from July 8 to July 11. The final results were announced on July 11. As a result, this extra week may constitute an important advantage for those who wish to enroll in university-major combinations that are in high demand. Indeed, data from one of our surveys lends support to this channel. Specifically, students were asked whether they were satisfied with the college and major they were enrolled in. For those who expressed discontent, the survey also asked for the reason they did not enroll in the institution/major of their choice. Amongst those who failed the first round, 11.9% answered that they were too late in enrolling in their first choice. This number decreases to 4.9% for those who passed on the first round.

Second, the documented variation in quality of education can be due to a discouragement effect. In fact, previous studies have shown that exit exams can discourage students by increasing high school dropout rates and lowering higher educational attainment (Martorell, 2004; Ou, 2010; Papay, Murnane and Willett, 2010). In our context—and as we show in section 5—failing on the first round exams does not affect Baccalaureate degree receipt since the second round is administered immediately after the first and has lower standards for passing (Buchaillat et al., 2011). Barely passing also has no effect on educational attainment

cialized universities only.
Source: Authors' calculations based on `http://data.enseignementsup-recherche.gouv.fr/explore/dataset/fr-esr-atlas_regional-effectifs-d-etudiants-inscrits`

since universities are not selective and students can always access institutions that are lower in demand. However, marginally failing students may still be discouraged by their first round results making them more susceptible to enroll in postsecondary institutions with lower skilled peers or in "worse" majors.

Third, colleges have access to the full Baccalaureate exam report (*"Le relevé de notes du bac"*) which states when a student passed his exams. Thus, they could perceive the timing of degree receipt as a signal of student ability, which would then factor into admissions decisions. This is reinforced by the fact that the second round of exams have lower standards for passing and are often deemed unreliable (see Buchaillat et al., 2011). By law, universities in France cannot be selective but they are capacity constrained. A recent report by the National Union of Students in France (L'Union Nationale des Etudiants de France) finds that some universities had been using the results from the Baccalaureate exam to select students into majors that were in high demand.[7] Thus, we cannot completely rule out selection by universities as a channel through which marginally failing the first round affects the quality of higher education.

3 Identification Strategy

We use a regression discontinuity framework (Lee and Lemieux, 2010; Imbens and Lemieux, 2008) to estimate the effects of passing the Baccalaureate exam from the first try on educational attainment, quality of education and future labor market outcomes. The key identifying assumption underlying an RD design is that all determinants of future outcomes vary smoothly across the threshold. In that sense, any observed discontinuity at the threshold can be attributed to the causal effect of scoring above a 10 on the Baccalaureate exam, i.e. passing on the first attempt. Formally, we estimate the following reduced form equation:

$$Y_i = \alpha + g(S_i) + \tau D_i + \delta X_i + \epsilon_i$$

where the dependent variable Y is the outcome of interest, representing earnings and educational outcomes for individual i. D is a dummy variable indicating whether a person passed or failed the French Baccalaureate exam on the first try. S is the running variable and represents an individual's score on the first attempt of the exam. It is defined as grade points relative to the threshold passing grade of 10. The function $g(.)$ captures the underlying relationship between the running variable and the dependent variable. We allow the slopes

[7]Sources: `http://lajeunepolitique.com/2013/07/29/27-french-universities-denounced-for-illegal-selecti` and `http://unef.fr/wp-content/uploads/2013/07/DOSSIER-DE-PRESSE-UNEF-2013-FII-11.pdf`

of our fitted lines to differ on either side of the passing threshold by interacting $g(.)$ with treatment D in order to control for differential trends in grades. X is a vector of controls that should improve precision by reducing residual variation in the outcome variable, but should not significantly alter the treatment estimates. The term ϵ represents the error term. The parameter of interest is τ which gives us the treatment effect for each regression.

In all regressions, we use population survey weights to estimate treatment effects for the various outcomes of interest.[8] Further, heteroskedastic adjusted errors are used in all regressions.[9] There are two ways to estimate the parameter τ in an RD design. First, one can impose a specific parametric function for $g(.)$, using all the available grade data, to estimate the above equation via ordinary least squares —typically referred to as the global polynomial approach. Alternatively, one can specify $g(.)$ to be a linear function of S and estimate the equation over a narrower range of data, using a local linear regression. In this paper, the preferred specifications are drawn from local linear regressions within 1.5 grade points on either side of the cutoff using uniform kernel weights. This avoids the problem of identifying local effects using variation too far away from the passing threshold. Our choice of bandwidth is motivated by graphical fit, data driven optimal bandwidth selectors and the existence of other cutoff grades. Specifically, we use a robust data driven procedure, outlined in Calonico, Cattaneo and Titiunik (2014), to predict the optimal bandwidths (Henceforth CCT).[10] This bandwidth selector improves upon previous selectors that yield large bandwidths. Specifically, it accounts for bias-correction stemming from large initial bandwidth choice, while also correcting for the poor finite sample performance attributed to this bias correction. While our preferred specifications are drawn from local linear regressions, we still present results for a variety of bandwidths and functional forms, as has become standard in the RD literature (Lee and Lemieux, 2010). The results are robust to these varying specifications leading us to conclude that passing the Baccalaureate exam from the first attempt results in significant differences in quality of schooling and subsequent labor market outcomes.

A standard concern with any RD design is the ability for individuals to precisely control the assignment variable. In our context, this can occur if students and/or graders manipulate scores in such a way that the distribution of unobservable determinants of education and earnings are discontinuous at the cutoff. The first concern is that students themselves are able to precisely sort to either side of the cutoff, especially given that the cutoff score is known beforehand. However, the Baccalaureate exam comprises all subject matter taken

[8]Results remain unchanged when using un-weighted regressions.

[9]Our running variable is fairly continuous as it is reported to the nearest one hundredth of a decimal point (i.e 9.91, 9.92, etc...). Accordingly, we are not too concerned about random specification error resulting from a discrete running variable as reported in Lee and Card (2008).

[10]The optimal local linear bandwidth for most of our specifications ranges from 1.2 to 1.5 score points.

during the year, most of which is in essay format, making it highly unlikely for any student to be able to precisely control their grade. A potentially more worrying concern is whether graders and administrators are sorting students to either side of the passing threshold in a non random way. Indeed, if borderline students with better future prospects are marginally passed at a higher rate than those with worse prospects, then our education and earnings estimates would most likely be upward biased.

It is highly implausible for initial test scores to be strategically manipulated since the names of all students are hidden from exam graders. However, following the grading of the first round exams, juries consisting of secondary school teachers decide on the conferral of the degree. A key part of the jury's role is to determine whether a person who is marginally below a certain cutoff should be given extra points to reach that corresponding threshold. Students are usually awarded extra points on the subjects for which they obtain the lowest scores. The jury member who specializes in the corresponding subject has to consent to giving the extra points. Decisions are made in a short period of time as juries need to go through hundreds of applications on a given day. Further, the juries tend to be fairly heterogeneous in their specializations. Students are not allowed to interact with jury members, nor do they know that their files are being reviewed until after the results are announced. Furthermore, students' names are hidden from the jury throughout the whole process, as to hinder any cheating or bribing.

The jury members observe students' Baccalaureate exams in all subject matter. They also have the option to access an academic report which contains teachers' evaluations of the student's performance in school, although anecdotal evidence suggests that this option is not always exercised. Additionally, even in cases where jury members take teachers' evaluations into consideration, they may still be basing their decision on an unreliable assessment of the student's performance in school. Previous studies show that the presence of test-based accountability distorts teacher behavior. For example, Jacob and Levitt (2003) provide evidence of teacher cheating on the Iowa Test of Basic Skills in Chicago elementary schools. Dee, Jacob, Rockoff and McCrary (2011) also show that teachers wanting to help their students, tend to inflate test scores on New York's high school assessment exams. In our context, it is possible that teachers' desire to help students might cause them to be more lenient in their evaluations.

In addressing potential grade manipulation concerns, we consider a few tests that have become standard in the RD literature. The first informative test would be to check for any discontinuity in the density of grades at the cutoff point (McCrary, 2008). The rationale behind this test is that if individuals are manipulating grades around the cutoff, then the grade distribution will be discontinuously uneven for grades just below and above the cutoff.

However, a running variable with a continuous density is neither necessary nor sufficient for identification. Specifically, this test may not be as helpful if discontinuities in the grade distribution can be attributed to other exogenous factors such as grade rounding.[11]

Generally, jury members are told to give special attention to students whose scores are marginally below a threshold. To investigate this issue, we take a closer look at the distribution of Baccalaureate test scores within a 9 to 11 grade window in Figure 1A. Noticeably, the distribution drops sharply and linearly in the range of 9.65 to 9.99 Baccalaureate points followed by a large density spike in the 10 to 10.05 score range. Further, when we pool all observations across all important cutoffs, as in Figure 1B, a similar if not more striking pattern emerges.[12] This sudden drop in the distribution followed by a spike is consistent with potential manipulation of test scores as reported in Dee, Jacob, Rockoff and McCrary (2011). Indeed, the data suggests that many students scoring within 0.35 points short of a cutoff have their grades bumped up to at most 0.05 points above the threshold. These students are identified as being prone to manipulation, as indicated by the filled circles in Figures 1 A and B. This heaping is consistent with a priori expectations that jury members are bunching grades at important cutoffs. These distributional discontinuities could be the result of strategic cutoff crossing, or an alternative non-strategic sorting process. While, the first case is obviously problematic, the latter poses no threat to identification.

Heaping in the running variable will only bias the estimates to the extent that it creates imbalances in outcome determinants around the cutoff (Barreca, Lindo and Waddell, 2016). As a result, a more informative test of strategic manipulation would be to check for the presence of significant discontinuities in determinants of outcomes. In section, 5.1 we conduct such tests and show that all determinants of outcomes are smooth across the threshold. However, in order to alleviate further concerns over bias, even in the presence of balanced characteristics, we use 'Donut' RD regressions as our baseline specification throughout the paper. These modified RD regressions involve dropping all manipulable data points around the threshold.[13] As a further robustness check, we also show that the results of the main Donut RD regressions are robust to the re-addition of the excluded manipulable points.

[11]See Zimmerman (2014) for such a case.

[12]Recall, that the cutoff grades of 8 ,10 ,12 ,14 and 16 all serve a specific purpose in terms of awarded degree.

[13]See Dahl, Løken and Mogstad (2014) and Zimmerman (2014) for similar applications of Donut RDs.

4 Data and Summary Statistics

4.1 Data

Our analysis uses data taken from a series of surveys, the "Panel d'élèves du second degré, recrutement 1995", administered by the French National Institute of Statistics and Economic Studies (INSEE). The surveys provide detailed individual-level information for a sample of 17,830 students who were enrolled in grade 6 (6ème) in the academic year 1995-1996. They follow students in secondary and postsecondary education as well as in the labor market. The data contains student demographics, detailed scores on the baccalaureate exams taken from administrative records, postsecondary field of study, institution attended and graduated, earnings information and employment status.

Data on postsecondary education are available on a semiannual basis for up to 9 years after receiving the General Baccalaureate degree. Labor market outcomes are reported yearly from 2005 to 2012, up to 10 years after the General Baccalaureate exam. Thus, one advantage of our dataset is that we are able to observe detailed long-term outcomes. A potential drawback of the data is that it does not include outcomes for individuals working abroad. Also, some individuals do not report their earnings or drop out of the sample because they could not be followed by interviewers. This could potentially cause problems insofar as it is correlated with treatment. We address these issues in section 5.1 by showing that there is no discontinuity in the probability of being observed in the labor market portion of the survey.

Another advantage of our data is that it provides detailed information on student outcomes measured prior to taking the Baccalaureate exam. These data help us evaluate whether marginal students on either side of the threshold are balanced on predetermined characteristics, an issue we discuss in detail in section 5.1. We have detailed test scores for three important national exams taken prior to the Baccalaureate exam. The first exam is administered at the beginning of grade 6. The goal of this exam is to evaluate the level of students in mathematics and its grading scale is from 0 to 78. We also have data on the Brevet national exam scores in three main subjects (Mathematics, French and foreign language). This national exam is administered in grade 9 and is required for entry into high school. It is graded from a scale of 0 to 20. The final national exam we look at is the oral and written French literature portion of the Baccalaureate exam. There are two advantages to looking at the results of this test. First, it is administered one year before all other Baccalaureate subjects. In that sense, it is a very recent indicator of student ability. Second, jury members cannot award extra points on this particular component of the Baccalaureate exam. Finally, we also have detailed information on academic and non-academic activities

4 years prior to the Baccalaureate exam. This information comes from a survey administered to students' parents between May and September 1998. The goal of this survey was to collect information on students' activities, home environment and parental involvement in their schooling.

4.2 Sample and Summary Statistics

We restrict our sample to students who sat for the first round of the General Baccalaureate exam in the academic year 2001-2002. We do not use the results from the second round because retaking the exam can induce differences between students who are marginally below and above the threshold (Martorell and McFarlin Jr., 2011). Further, the second round exams can be strategically manipulated as they are conducted orally and administered by only one teacher. We also exclude students who attended vocational secondary schooling as their post-Baccalaureate academic options are limited. Finally, in our empirical analysis, we use earnings reported approximately 9 to 10 years after taking the baccalaureate exam, when the students are aged between 27 and 29. This is mainly because earnings of individuals in their early twenties are not usually considered a good predictor of future income. This results in up to two observations for each individual, stacked for the years 2011 and 2012.

Table 1 presents survey weighted means for education and labor marktet outcomes as well as demographic and academic baseline characteristics.[14] Column 1, which contains all students in the sample, shows that the average Baccalaureate score for first time test takers is 11.19 points. Further, 75 percent of students pass from the first attempt, with 98 percent eventually passing the Baccalaureate and obtaining their high school degree. Students acquire an average of 3.2 years of postsecondary education. Table 1 also reports the proportion of students enrolled in a STEM designated major or a business degree. We group these two types of degrees together since business degrees are associated with earnings that are comparable to STEM degrees (Arcidiacono, Aucejo and Hotz, 2016). A complete account of the majors we designate as STEM versus non-STEM can be found in Appendix C3. We find that 35 percent of students in the overall sample enroll in a STEM major in college. Table 1 also reports average employment and wage outcomes separately for the years 2011 and 2012. The employment rate stands at 93 percent for the whole sample for both years. Further, the average student earns around €1660 and €1762 for the years 2011 and 2012 respectively.

Summary statistics for students' demographic characteristics as well as prior academic performance are also reported in Table 1. Column 1 reveals that 38 percent of students in

[14]The reported means are unchanged when no survey weights are used.

the overall sample are male.[15] Virtually all students are born in France (97 percent) and a majority of them are living with both parents (88 percent). 59 percent of respondents have a father who is a high-skilled worker.[16] Students from the overall sample score an average of 11.2/20, 61.5/78 and 13.71/20 points on the grade 11, 6 and 9 national exams respectively. We also report detailed average outcomes for parental discipline, student activities and parental involvement, which can be found in Appendix Table A1.

Column 2 of Table 1 limits the sample to marginal students, i.e. those scoring within 1.5 baccalaureate points on either side of the passing threshold. Across all important dimensions, marginal students tend to be worse off than the average student. This is not surprising since, as previously mentioned, students at the cutoff are low skilled. Specifically, scoring at the passing threshold puts a student at the 28th percentile of the skill distribution of first time General Baccalaureate exam takers.[17] Marginal students score one point less on the Baccalaureate exam—which amounts to a 45 percent of a standard deviation difference. Fewer students pass on the first round (69 percent), although more students (99 percent) end up passing overall.[18] Marginal students spend less time in postsecondary education and are less likely to enroll in STEM majors. They also have a lower likelihood of employment in the future and earn substantially less than students from the overall sample. When compared to the overall sample, marginal students are slightly less likely to be male and have a lower portion of students originating from a high socioeconomic background (53 percent). In terms of prior academic performance, marginal students perform substantially worse in all national exams. However, parents' opinions about their childrens' schooling are similar to those of the overall sample.

The sample in column 3 of Table 1 involves dropping all marginal students whose test

[15]51.61 percent of the students in our initial sample are male. This number is reduced to 38 percent after excluding students who were in vocational secondary schooling. However, this does not pose any threat to identification, as we observe no discontinuity in the likelihood of being of a certain sex at the threshold.

[16]We use occupation to get the share of students with a high-skilled father. The occupation of the father is stratified into 42 different positions that are represented by two digit identifiers. The first digit of each identifier represents one of four main skill levels. These skill levels are the official French socioeconomic classification as represented by the "Nomenclature des professions et categories socioprofessionelles" (PCS) and are used as a reference in all official collective agreements. Our definition of high skilled workers includes the first two skills levels, while low skilled workers are represented by the last two.

[17]We also use an alternate measure to provide an upper bound for where the marginal student falls in the distribution of university attendees. Given that not all students who attend universities sit for the General Baccalaureate exam, we use the results of the grade 9 middle school exit exam (Brevet exam) that is common to all eventual university attendees. With this method, the students at the cutoff fall in the 36th percentile of the skill distribution of all university attendees in our sample. This is comparable to the relatively low skilled students in Goodman, Hurwitz and Smith (2015) who fall in the 34th percentile of all Georgia SAT takers.

[18]This ratio is higher for all marginal subsamples, mainly because only extremely low performing students (scoring less than 8) are at the highest risk of never obtaining a high school degree.

scores could have been manipulated, our preferred Donut RD sample. Importantly, we find no substantial mean differences between the marginal donut sample and the marginal sample in column 2. These two subsamples are identical in virtually all outcomes and controls, except for a slight difference in reported earnings. This suggests that grading bias may not be a substantial issue in this study. We return to this in detail in section 5 by showing that baseline covariates are balanced at the threshold and the similarity of estimates between donut and traditional RD regressions. Finally, in column 4, we report means for the donut RD student sample who have at least one observed wage (including zero) in either 2011 or 2012. All outcomes are similar in magnitude as compared to the marginal Donut sample in column 3, indicating that the sample from the labor force survey is similar in composition to the sample from the initial education survey. Given the consistency of subsamples across columns 3 and 4, the preferred baseline RD regressions in this paper are drawn from the marginal Donut RD sample (column 3). Using this sample allows us to improve precision without compromising bias. This is important, particularly when we are looking at heterogeneous treatment effects.

5 Main Results

5.1 Validity of the Research Design

As mentioned in section 3, heaping in the running variable will only bias the estimates to the extent that it creates imbalances in outcome determinants around the cutoff. As an important RD validity check, we test for potential imbalances in student baseline characteristics. We consider several student characteristics that are known to be a good predictor of earnings: prior academic performance, demographic characteristics, indicators of parental discipline, student activities and parental involvement.[19] We summarize all these effects by checking whether predicted log earnings, as a function of the above covariates, are smooth around the passing threshold. Figures 2A and 2B reveal no visible discontinuity at the threshold using a local linear and global fit respectively. These figures take the same form as those after them in that circles represent local averages over a 0.25 score range. Panel A of Table 2 shows regression discontinuity estimates over varying bandwidths and functional forms with standard errors reported in parentheses. We do not find any statistically significant effects of treatment on predicted earnings, except for a 10% level of significance when comparing means for those scoring within 0.5 points on either side of the cutoff. Figures A1 through A4 present estimates of the effects of threshold crossing on baseline characteristics

[19]See Table 1 and Appendix Table A1 for a detailed list of variables.

separately with no visible discontinuities at the cutoff in any of our variables. We also show regression based estimates for all separate baseline characteristics over varying functional forms and bandwidths in Tables A2 through A5. Virtually all estimates are statistically insignificant over varying bandwidths.[20]

As a further RD validity check, we also show that there is no significant threshold crossing effect on the likelihood of students being observed in the follow-up wage survey. If marginally failing students were more likely to leave the country in order to have access to higher quality universities or if they endogenously chose not to respond to the follow up survey as a result of failing, then that would complicate the interpretation of our results. These results are summarized graphically in Figure 2C, with estimates reported in Panel B of Table 2. The absence of any differential selection into the earnings sample alleviates any concerns attributed to leaving the sample due to barely failing the French Baccalaureate exam.

Taken together, these results are consistent with the fact that students' identities are never disclosed to neither graders nor jury members and suggest the absence of any meaningful strategic sorting on the part of jury members. However, in order to alleviate further concerns over bias, even in the presence of balanced characteristics, we use Donut RD regressions as our baseline specification throughout the paper. These regressions drop all manipulable data points around the threshold, i.e. all students scoring between 9.65 and 10.05 points. Table A7 shows Donut RD regressions for the predicted earnings variable taken after regressing log earnings on all predetermined characteristics. The estimates do not indicate robust statistically significant effects, suggesting that our baseline trimmed control and treatment groups are still similar on observable characteristics.

5.2 Impact on Quantity of Education

In this section, we investigate whether marginally passing the Baccalaureate exam on the first round affects quantity of education. All panels in Figure 3 show graphically the relationship between outcomes related to quantity of education pursued as a function of first time scores on the French Baccalaureate exam. All figures take the same form as those after them in that circles represent local averages over a 0.25 score range. Further, all figures are drawn over a bandwidth of 1.5 Baccalaureate points on either side of the cutoff using a linear fit. Figures 3A through 3D respectively show no visible discontinuities in the probability of eventually obtaining a high school degree, enrolling in postsecondary education,

[20] In Table A6, we also show that the baseline characteristics are smooth around all other important thresholds. Indeed, if juries were strategically manipulating results, then this phenomenon should occur at all important cutoffs. We find no evidence of significant discontinuities at any of these cutoffs for our above baseline covariates. In separate regressions, available upon request, we also check for the existence of threshold crossing effects on education or labor market outcomes and find none.

eventually attaining a postsecondary degree and in completed years of postsecondary education. However, Figure 3E reveals an increase in the age of postsecondary graduation at the cutoff.[21]

Having shown the raw patterns of educational attainment around the passing threshold, we now turn to regression-based estimates. Specifically, Panel A of Table 3 reports our baseline specification which involves local linear Donut RD regressions using the sample of students scoring 1.5 Baccalaureate points on either side of the cutoff. Consistent with the visual evidence, we find no statistically significant discontinuity in high school graduation rates, college enrollment rates, college graduation rates and years of postsecondary educational attainment. These results are reported in columns 1 through 4 of Panel A respectively. We do however find a statistically significant 0.689 year increase in age at graduation from a postsecondary institution as shown in column 5. Panel B of Table 3 restricts our sample to students who have a reported wage in the data (including zero). The results from these regressions are consistent with those of Panel A, although precision is reduced, which is to be expected given the smaller sample size. The similarity of results between Panels A and B is consistent with the fact that we observe no discontinuity in the likelihood of a student being observed in the follow-up labor market survey.

With the caveat of reduced precision, due to small samples, we next look at heterogeneous treatment effects by socioeconomic status. These subgroups are particularly interesting to study as parental income is highly correlated with students' access to higher education and there is clear evidence that low-income students tend to make suboptimal decisions in education (Roderick et al., 2008; Bowen, Chingos and McPherson, 2009; Smith, Hurwitz and Howell, 2013). Panel C of Table 3 stratifies the marginal sample into high versus low socioeconomics status (S.E.S). The results for high S.E.S students are consistent with those of the overall sample. High income students exhibit no statistically significant differences in educational attainment or graduation at the threshold, but are 0.759 years older at time of postsecondary graduation. As for low income students, all outcomes are statistically insignificant, though imprecise, precluding us from making any definitive conclusions for this subgroup.

We also look at heterogeneous effects by high school concentration. As previously stated, French students must choose a concentration to focus on during high school. This particular attribute of the French schooling system gives us the advantage of being able to look at the effects of first time passing for students investing heavily in a scientific versus non-scientific (i.e. economics & sociology or literature) high school curriculum. Panel D of Table 3 reveals

[21]Global polynomial figures for all "Quantity of education" variables can be found in Appendix Figure A5.

that students who concentrated in the sciences in high school do not exhibit statistically significant increases in graduation rates or educational attainment. When we focus on the subgroup of students who graduated with a non-sciences high school concentration, we find that they are not more likely to graduate high school at the threshold, but first time passing increases their likelihood of college graduation by 23.2 percentage points. Further, age at graduation from college is not statistically significant for this subgroup of students.

In Appendix Table A8, we show that the baseline results reported in Panel A are robust to a variety of checks. The results from our Donut RD regression are unchanged over a wide array of bandwidths and functional forms. Further, they are robust to the addition of controls. These controls include exam specialization fixed effects, date of birth, regional controls, gender, socioeconomic status, scores on the Brevet examination, scores on the French portion of the Baccalaureate taken in grade 11 and scores in the grade 6 national assessment exam in Mathematics.[22] Finally, we show that the results of the main Donut RD specifications are robust to the re-addition of the excluded manipulable points, although the discontinuity in age at graduation for the Non-Donut RD specification is not statistically significant over varying bandwidths and functional forms.

5.3 Impact on Quality of Education

In the previous section, we find that passing the General Baccalaureate on the first attempt has no effect on educational attainment in terms of enrollment, graduation or effective years of education in high school or college. We do however find that it does have an effect on age at postsecondary graduation. This suggests that marginally passing students take more time to graduate college, indicating that they may be pursuing a more difficult post Baccalaureate education route. Consequently, we next look at the impact of threshold crossing on the quality of institution attended and the likelihood of enrolling in a STEM major.

We rely on in-sample institution average Baccalaureate score, i.e. peer quality, as a proxy for institution quality.[23] Thus, we consider a university to be of "higher quality" if it has better performing peers. Figure 4A reveals a significant jump in average institution peer quality at the threshold for the marginal sample.[24]

[22]We focus on these covariates as they are the most important predictors of future outcomes and the most likely predictors of potential manipulation in our sample. Further, these covariates do not suffer from missing observation issues.

[23]A potential drawback to this approach is that the relatively small number of observations within each institution could lead to inference problems. Specifically, all individuals within the same institution share a common measurement error component. We correct for this by clustering at the institution level thus allowing for a grouped error structure.

[24]The negative slope on the left hand side of the cutoff is consistent with a first come, first served admissions mechanism (See Section 2.2 for details). Specifically, students scoring just shy of a cutoff are

Column 1 of Table 4 shows estimated impacts on peer quality from Donut RD regressions, while column 2 presents those same estimates as a percent of a standard deviation in Baccalaureate scores. Using the marginal sample, we find a significant threshold crossing effect to the order of 0.315 Baccalaureate points in Panel A. This indicates that the average peer quality that students experience in college increases significantly and discontinuously—to the order of 0.142 of a standard deviation in Baccalaureate scores—as a result of passing from the first attempt. Panel B restricts the sample to only those with reported wages, with results remaining similar in magnitude (0.305). In Panel C, we check whether these observed peer differences persist for low versus high income students. High S.E.S students attend a university with peers who are 19.7 percent of a standard deviation better. However, we observe no statistically significant change in peer quality at the threshold for low S.E.S students, though the degree of imprecision for this estimate precludes us from ruling out effects as large as those of the overall sample. In Panel D, we further check for any differences in peer quality based on high school concentration. Students majoring in the sciences in high school as well as those concentrating in non science subjects both exhibit statistically significant increases in peer quality that are consistent with the overall sample.

Students in France simultaneously enroll in a postsecondary institution and field of study. Specifically, in the French education system, many universities are specialized in certain fields of study making college major an important dimension of college quality. Consequently, we next check whether there is a discontinuity in the likelihood of students enrolling in a STEM versus non-STEM major. Figure 4B reveals a sizable jump in the likelihood of majoring in a STEM field at the threshold for the marginal sample. Panel A of Table 4 reports estimated effects on the likelihood of STEM enrollment from the baseline Donut RD regressions. We find that first time passing leads to a 23.4 percentage point increase in the likelihood of a student enrolling in a STEM major. When we restrict our sample to those who have a reported wage, as in Panel B, we find a statistically similar 19.2 percentage point increase. Panel C highlights an interesting point; both high and low income students are more likely to major in STEM fields when given the opportunity, though this effect is more pronounced for low income students. Finally, we show that this increase in STEM enrollment at the threshold is driven by students who concentrated in the sciences in high school. These students are 31 percentage points more likely to major in a STEM field, whereas those concentrating in the social sciences, arts and humanities in high school are not shifting into the sciences in

more likely to pass on the second round than those farther to the left of the cutoff, who are more likely to pass on the first round of the following year. The unintended consequence of this is that students farther to the left of the cutoff have a better pick of universities the following year. However, we must also note that the negative slope is not statistically significant. In Appendix Figure A6, we also present global polynomial figures that reveal the entire fit.

college.

In Appendix Table A9, we show that the baseline results reported in Panel A are robust to a variety of checks. The results of our Donut RD regressions are largely unchanged over a wide array of bandwidths and functional forms as well as the addition of controls. Finally, we show that the results of the main Donut RD specifications remain significant even after the re-addition of the excluded manipulable points. In fact, for both quality outcomes, treatment effects are slightly reduced, which goes against what would be expected if strategic sorting on the part of jury members were present.

As detailed in Section 2.2, various features of the baccalaureate exam lend themselves to the observed shift in quality of education at the first time passing threshold. First, universities generally enroll students on a "first come, first serve" basis and students need to have proof of Baccalaureate receipt in order to enroll in universities. Thus, passing on the first try gives students an important time advantage for those who wish to enroll in university-major combinations that are in high demand. Second, marginally failing students may be discouraged by their first round results making them more susceptible to enroll in non STEM majors or universities with lower skilled peers. Third, universities could perceive the timing of degree receipt as a signal of student ability, which would then factor into admissions decisions.

The data allow us to observe whether an individual graduates from a certain institution rather than just being admitted to an institution. This is potentially important as completion rates are sometimes low and vary across institutions, which would in turn complicate the interpretation of the results. Consequently, we present visual evidence of a discontinuity in the quality of institutions that students graduate from as well as the likelihood of graduating with a STEM-designated major in Appendix Figures A7a and A7b. All figures show a clear discontinuity at the threshold, similar to the initial attendance figures. The estimates from Donut RD regressions predict a 25 Baccalaureate point (11.5 percent of a standard deviation) increase in peer quality as well as a 11 percentage point change in the likelihood of STEM graduation at the threshold—a reduction from the enrollment estimates. This leads us to conclude that any potential labor market effects should be the result of both attending and graduating with higher quality schooling.

5.4 Impact on Labor Market Outcomes

We now examine whether the documented variation in quality of education is associated with positive labor market returns. Before analyzing the reduced form effects of first time passing on earnings, we first check for employment effects. Figure 5A shows a smooth relationship between employment and the distance from the first round exam cutoff. The corresponding regression estimate from our baseline Donut RD (Panel A of Table 5) reveals statistically insignificant reduced form effects on employment. In Panels B and C of Table 5, we also find no employment effects for students based on socioeconomic status or high school concentration, although these results are imprecisely estimated.

We then explore whether threshold crossing affects earnings. Specifically, we focus on the average monthly net earnings for the years 2011 and 2012. The earnings from both years are stacked, resulting in up to two observations per individual. Accordingly, standard errors are clustered at the individual level throughout. Figures 5B and 5C reveal striking discontinuities in the level of monthly earnings as well as logged monthly earnings at the threshold.[25] Donut RD estimates from Panel A of Table 5 confirm that these visually apparent discontinuities are statistically significant and economically meaningful. We find that threshold crossing leads to a €268 or a 11.8 log point (12.5 percent) increase in earnings. These reduced form earnings results are also apparent when we stratify our sample by socioeconomic status. Column 2 of Panel B reveals that high income students at the threshold earn a €348 monthly wage premium as compared to their marginally failing counterparts. Similarly, results suggest that low income students are also earning more at the threshold, though this estimate is not statistically significant at conventional levels. We reach a similar conclusion when we focus on logged earnings as the main outcome of interest. Strikingly, in Panel C, we find that the documented increase in earnings at the threshold is mostly driven by students majoring in the sciences in high school. We find no statistically significant earnings effects for non-science students, although we can not rule out economically meaningful effects.

Finally, in Appendix Table A10, we show that our baseline results for employment and earnings are not significantly changed over a wide array of bandwidths and functional forms as well as the addition of controls. Importantly, we also show that the results from the main Donut RD specifications remain significant and similar in magnitude, even after the re-addition of the excluded manipulable points. We conclude that while passing the Baccalaureate exam on the first try does not affect the likelihood of employment, it does significantly alter future earnings. In what follows, we provide a detailed interpretation of all our results.

[25] Global polynomial figures for all "Labor market" variables can be found in Appendix Figure A8.

6 Discussion

6.1 Interpreting the documented labor market premium

We interpret our results as intent to treat (ITT) effects whereby increased access to higher quality education results in a 12.5 percent earnings premium for the low skilled student. Our "first stage" results show that a significant proportion of students who pass from the first round attend a college with higher performing peers and/or are more likely to pursue a STEM major. This allows us to measure the effect of increased access to higher quality education on later lifetime outcomes, but not the effect of any specific change in higher education quality.

Our interpretation hinges on the fact that only quality of education dimensions vary at the cutoff. As a result, we rule out other potential channels through which marginally passing the Baccalaureate exam on the first round could affect earnings. First, we show that there is no impact on the likelihood of ever being awarded the Baccalaureate degree. This is not surprising as students are required to hold the degree if they wish to enroll in postsecondary education. Furthermore, students who want to enter the labor force immediately after high school could use the baccalaureate degree as a signal of their ability to potential employers. Therefore, students are incentivized to retake the exam until they are awarded the degree. This is in line with recent evidence which finds that exit exams do not cause increased high school dropout rates (Clark and See, 2011). Second, we find that threshold-crossing has no impact on the likelihood of enrollment or graduation from a postsecondary institution. We also find no effect on completed years of postsecondary education. These results are expected given the vast number of non selective universities and majors in France whose only requirement for admission is holding the Baccalaureate degree.

Another factor that could affect the interpretation of our estimates is that the documented increase in earnings could be driven by employers who use passing on the first round as a signal of productivity. To alleviate such concerns, we focus on a segment of the population who have chosen not to attend college, a decision we have shown not to be affected by threshold crossing. If employers are using the first round of the Baccalaureate exam as a signal of productivity, then we would expect the signal to be most pronounced for this segment of the population. Appendix Figure A9 reveals no compelling evidence of a discontinuity at the threshold. The corresponding estimate in the figure involves a global quadratic regression, mainly because there is insufficient data to run meaningful local linear regressions. While the global RD estimate is imprecise due to small sample issues, it is still comforting to see that there is no discernible discontinuity at the cutoff. Furthermore, it is unlikely that employers are able to distinguish students who marginally pass and marginally fail the first round exams. This is mainly because the Baccalaureate diploma does not explicitly state whether one has passed from the first round or not. An employer would have to ask for a student's full Baccalaureate exam report (*"Le relevé de notes du bac"*) in order to obtain such information, which seems unlikely—especially for our sample of students who attend college and have higher degrees.

A final concern is that age of postsecondary graduation varies at the threshold. Indeed, we cannot rule out that marginal passers are around 0.7 years older than those who barely failed at the time they graduate college (Column 5 of Table 3). The fact that students are graduating with the same effective years of education, yet are still older at graduation, suggests that marginally passing students are taking more time than usual to graduate college.[26] This heightened time to graduation is most likely explained by the fact that marginal passers are pursuing education that is of higher quality and rigor. This ultimately results in a loss of early labor market experience. To the extent that early work experience is positively correlated with earnings in the French educational system, this would cause us to understate the impact of quality of education on earnings.[27]

6.2 Additional Results on Quality of Education

We have shown that marginally passing the first round Baccalaureate exam leads to variation in postsecondary peer quality and majors. In this section, we investigate the main sources of these effects.

Across and within college sector shifts The French postsecondary education system comprises four college sectors: the *Grandes Ecoles*, vocational institutes, vocational degrees in lyceums, and universities. One possible explanation for the documented differences in peer quality and majors at the threshold is that students are being shifted across these different postsecondary sectors. To test this, we plot the probability of students being in each of the four academic sectors in Appendix Figures A11A through A11D. We observe no visible sectoral shifts at the threshold. Appendix Table A11 further reports no statistically significant treatment effects for any of these outcomes using both Donut and Non-Donut RDs, though the estimates are fairly imprecise.

With the lack of compelling evidence for cross-sector movements, we next look at whether

[26]We rule out the possibility that students are older by the time they graduate high school by showing that age at Baccalaureate receipt is smooth throughout the cutoff (Appendix Figure A10).

[27]From our sample, we estimate that a year of early work experience increases wages by around 4 percent using a Mincer type regression. Thus, a 0.7 year loss of work experience could have resulted in a 2.8 percent decrease in earnings for marginal passers, suggesting that the wage returns to increasing access to higher quality education could be as high as 15 percent at the threshold.

students are being shifted within the university sector. Our focus on the university sector is motivated by the fact that most students in our marginal sample attend universities. Furthermore, some universities are specialized in certain fields of study while others offer a wide variety of majors. This may lead to students sorting to different types of universities, which could explain the increase in peer quality at the passing threshold. Consistent with this idea, Appendix Figure A12A shows a clear increase in the probability of enrolling at any specialized university. The corresponding Donut RD estimate, reported in Appendix Table A12, is statistically significant and to the order of 14.4 percentage points. As Figure A12B reveals, students seem to be diverted away from multidisciplinary universities as we see a decrease in the probability of enrolling at such universities.

Given that students are moving to different types of universities, a natural next step is to look at whether changes at the major level also occur within this sector. Appendix Figure A12C reveals a sizable jump in the likelihood of enrolling at a university as a STEM major. The corresponding Donut RD estimate in Appendix Table A12 predicts a 19.5 percentage point increase in the likelihood of STEM enrollment. This is concurrent with a 12.8 percentage point decrease in the probability of enrolling in a university as a humanities, arts or social sciences major, while enrollment in law and political science at universities is unchanged. The findings from this section highlight an important distinction between this paper and Goodman, Hurwitz and Smith (2015) as well as Zimmerman (2014) who also look at the effects of college quality. Specifically, students at the margin in our study are moving between traditional universities that all offer the same type of degrees. This is in contrast to the aforementioned studies which look at students on the margin of attending a 4-year college versus a 2-year community college in the U.S. This could potentially explain why we do not document increases in graduation rates at the cutoff as in the Goodman, Hurwitz and Smith (2015) paper, even though—similar to the U.S.—France suffers from low overall bachelor's degree completion rates.

Other quality measures So far, we have documented that threshold-crossing changes both the major and type of university attended. We also observe an increase in institution-level peer quality, which indicates that the type of universities that students are moving to are of higher quality. We next examine whether these universities are different in terms of other measures of quality. Appendix C1 describes the data used for these new measures of university quality.

Following Goodman, Hurwitz and Smith (2015), we use bachelor's degree (or *Licence*) completion rates as an alternative measure of university quality. For each university, this variable is defined as the fraction of students who initially enrolled at that university and graduated with a bachelor's degree within four years from any university. Figure 6A and the corresponding Donut RD estimate in Table 6 reveal an insignificant treatment effect on university level BA completion rates at the first time passing threshold. As another measure of quality, we also look at university dropout rates across the cutoff. For each university, this variable is defined as the fraction of students who initially enrolled at that university and did not enroll in any postsecondary institution the following academic year. Figure 6B does not reveal any visible discontinuity in university dropout rates at the threshold. Consistent with the visual findings, the corresponding Donut RD estimate in the second column of Table 6 is statistically insignificant for the marginal sample.

Another measure of quality we consider is a university's funding per student. Higher university resources could increase human capital accumulation which would lead to a rise in earnings.[28] Universities in France are publicly funded. Prior to 2009, they received funds based on their needs. The main factors that determined funding were the number of students, full-time employees and the space used for teaching. After 2009, funding was allocated based on the university's needs and performance. Some of the performance measures used are bachelor's degree completion and persistence rates, students' employability and the university's research output. Funding data was only made publicly available starting 2009, but students in our sample enrolled in universities in the academic year 2002-2003. Thus, one caveat to keep in mind when interpreting the funding results is that students in our sample were only exposed to the needs-based funding criteria, while the data we have access to also incorporates university performance. Average university funding per student is €7,222. Figure 6C shows no clear difference between universities' funding-levels around the cutoff and the corresponding Donut RD estimate reported in the third column of Table 6 is also statistically insignificant, though imprecise.

6.3 Impact of STEM enrollment versus quality of peers

So far, we have argued that the rise in earnings at the threshold is driven by increases in STEM enrollment and institution-level peer quality. An interesting question is which of these two components of education quality is contributing more to the earnings effects. Conclusively disentangling the impacts of STEM enrollment and peer quality is beyond the scope of this paper, since both variables are endogenous to treatment. Nonetheless, in this section, we provide suggestive evidence as to whether one or both factors are more predictive

[28]The two classical channels through which quality of higher education can affect earnings are human capital formation and signaling. While it is difficult to provide evidence for these mechanisms, higher university resources would favor the human capital channel. One test of the signaling channel would be to look at whether the earnings effect decreases with age (Hoekstra, 2009). Our data only allows us to observe detailed labor market outcomes between the ages of 27 to 29. Thus, we are unable to perform this test.

of the increase in earnings.

We start by comparing our estimates to those from other work on college quality. This is complicated by the fact that most of the literature does not account for differences across institutions in student composition by field or does not observe such differences. However, we are still able to abstract from this literature to understand the relative importance of peer quality. For example, Black and Smith (2006) find that attending a U.S. university with a 1 percent standard deviation higher mean SAT score results in a 4 to 6 percent increase in earnings, depending on the specification used. Assuming that average peer quality is comparable across both contexts, then that means that the documented 0.15 standard deviation increase in mean Baccalaureate scores we observe at the threshold can only explain a modest 1 percentage point (8 percent) of the 12.5 percent earnings premium.[29] This suggests that the large discontinuity we observe in STEM enrollment may be driving the earnings results. Furthermore, Kirkbøen, Leuven and Mogstad (2016) address the potential endogeneity of field of study choices by instrumenting completed institution and field with predicted institution and field. They find little evidence that graduating from a better institution matters once field of study is held constant, suggesting that the labor market returns from attending a more selective institution tends to be relatively small as compared to payoffs to field of study in their context.[30]

While previous literature suggests that choice of major might be a more important contributor to the rise in earnings, we still attempt to shed light on this question in our context. To do so, we look at how threshold crossing affects major level wages. We then examine how this effect changes when we focus on wages measured at the university-major level. This would inform us as to whether such measures are good predictors of individual level earnings (See Goodman, Hurwitz and Smith, 2015). If so, the magnitude of these estimates could provide suggestive evidence as to whether majors are driving most of the earnings effects, as

[29]It turns out that the estimates from simple linear regressions of peer quality on earnings are similar across both papers. Black and Smith (2006) find that a one standard deviation change in peer quality is associated with a 2.5 percent increase in earnings in the U.S. using a simple OLS regression. In Appendix Table A13, we find that a one standard deviation increase in peer quality is associated with a 4 percent increase in earnings. This estimate is reduced to 2.4 percent after controlling for Baccalaureate test scores.

[30]Assuming that STEM enrollment were the only relevant quality variable varying at the threshold, we find that the returns to STEM enrollment in college is as high as 63 percent—although this estimate is best thought of as an upper bound. Interestingly, this estimate, though large, is still well within the estimates of the returns to STEM oriented majors found in Table IV of Kirkbøen, Leuven and Mogstad (2016). They find that the returns to majoring in the fields of Science, Technology or Engineering can range from 50 to 300 percent when the counterfactual major is in the humanities, Social Science or Teaching. We present these separate IV estimates on the impact of STEM enrollment and peer quality on earnings in Appendix Table A13. We note that we present these IV estimates in a descriptive sense. Indeed, instrumenting a specific measure of college quality with the threshold would not yield a strict instrumental variable interpretation since, as shown in the paper, other aspects of education quality change discontinuously at the cutoff.

indicated by the previous literature.

The variables we use are defined as the natural log of average wages for all students who graduated with a masters' degree from a specific major or university-major combination.[31] Appendix C1 provides a description of the data and sample construction. Although we focus on students who are enrolled in a bachelor's degree in our main analysis, earnings information based on students who graduated with a master's degree is still informative. First, a sizable share of students who have a general baccalaureate degree and choose to pursue postsecondary education eventually obtain a master's degree.[32] Second, around 58% of students who choose to pursue a master's degree do so at their undergraduate university.[33]

Figures 7A and 7B show clear increases at the cutoff for both measures. This indicates that wages measured at the major and university-major levels are good at predicting individual level wages. Table 7 further reveals that students who marginally pass, pursue majors that are associated with 3.9 log points higher wages, compared to the majors chosen by those who marginally fail. The university-major level estimate is larger. Threshold crossing induces students to attend university-major combinations with 7 log points higher wages.[34]

Based on these results, we cannot conclusively say whether major choice is a more important predictor of student earnings. In fact, the impact on earnings at the university-major level is noticeably larger than that at the major level. Further, the university-major level estimate is closer in magnitude to our individual level earnings effects. These findings suggest that students do realize earnings gains from enrolling in STEM versus non-STEM majors. However, returns might be even larger when combining higher quality universities with STEM majors. Although these results are merely suggestive, they are in the same spirit as those by Carrell, Fullerton and West (2009) and Brunello, De Panola and Scoppa (2010) who find that academic returns to better peers are higher in science and math courses as opposed to humanities and social sciences.

[31]We do not have data on wages measured at the university level. It is also difficult to create this variable since some university-major wages are missing from our data.

[32]Using the 2009-2011 Labor Force Survey, we estimate that among individuals aged 25 to 29 who have a general baccalaureate and postsecondary degree, 18% have a bachelor's degree only (*licence*) and 23.27% have a master's degree.

[33]Source: Authors' calculations based on "Parcours et réussite aux diplômes universitaires: Attractivité M1-M2"

[34]The individual level earnings effects from our main analysis are still larger than the university-major estimates. One possible reason for this disparity is that we are using information based on students who graduated with a master's degree while in our main analysis students initially enroll in bachelor's degree.

7 Conclusion

This paper looks at whether low-skilled students gain from an increase in quality of higher education. We exploit the fact that students in France have to pass a national exam to graduate from high school and enroll in universities. Using a regression discontinuity design, we compare the education and labor market outcomes of students who marginally pass and marginally fail the exam from the first attempt. We find that marginally passing has no effect on the quantity of education pursued. It does however improve the quality of peers that students are exposed to in their postsecondary institution and increases the likelihood of enrolling in a STEM major. Marginally passing also leads to a 12.5 percent increase in earnings at the age of 27 to 29. We interpret our findings as intent to treat effects whereby having the opportunity to access higher quality postsecondary education results in a significant earnings premium for low-skilled students.

We believe that this paper contributes to the understanding of how education affects different types of individuals. Our results can be seen as complementing recent findings which indicate that low-skilled students realize labor market and educational gains from accessing 4-year colleges in the U.S. (Zimmerman, 2014; Goodman, Hurwitz and Smith, 2015). Specifically, we show that these gains are not restricted to increasing low skilled students' access to college, but are also realized by increasing their access to better quality universities and majors. The scope for policy depends on the mechanisms driving these gains and the extent that our results can be generalized to other settings. Our findings are important in light of the fact that there is a growing need to inform student choice, given soaring tuition costs coupled with the fact that governments around the world have been setting goals of increasing the number of STEM graduates.

References

Andrews, R.J., Li, J., Lovenheim, M.F., 2016. Quantile Treatment Effects of College Quality on Earnings. *The Journal of Human Resources* 51 (1): 200-238.

Arcidiacono, P., Aucejo, E.M., Hotz, V.J., 2016. University Differences in the Graduation of Minorities in STEM Fields: Evidence from California. *American Economic Review* 106 (3): 525-562.

Barreca, A.I., Lindo, J.M., Waddell, J.R., 2016. Heaping-induced bias in regression discontinuity designs. *Economic Inquiry* 54(1): 268-293.

Black, D.A., Smith, J.A., 2006. Estimating the Returns to College Quality with Multiple Proxies for Quality. *Journal of Labor Economics* 24 (3): 701-728.

Bowen, W.G., Chingos, M.M., McPherson M.S., 2009. Crossing the finish line. *Princeton: Princeton University Press.*

Brewer, D., Eide, E., Ehrenberg, R., 1999. Does it Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings. *Journal of Human Resources* 34 (1): 104-123.

Brunello, G., De Paola, M., Scoppa, V., 2010. Peer Effects in Higher Education: Does the field of study matter? *Economic Inquiry* 48 (3): 621-634.

Buchaillat, M., Fort, M., Gauthier, R.F., Olivier, M., Steiner, R., Mathias, P., Kesler, S., 2011. Propositions pour une évolution du baccalauréat. *Rapport de l'inspection générale de l'éducation nationale No 2011-117.*

Calonico, S., Cattaneo, M,D., Titiunik, R., 2014. Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs. *Econometrica* 82 (6): 2295-2326.

Carrell, S, E.,Fullerton, R, L., West, J, E., 2009. Does your cohort matter? Measuring peer effects in college achievement. *Journal of Labor Economics* 27 (3): 439-464.

Clark, D., See, E., 2011. The impact of tougher education standards: Evidence from Florida. *Economics of Education Review* 30 (6): 1123-1135.

Dahl, G.B., Løken, K.V., Mogstad, M., 2014. Peer Effects in Program Participation. *American Economic Review* 104 (7): 2049-2074.

Dale, S.B., Krueger, A.B., 2002. Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables. *The Quarterly Journal of Economics* 17 (4): 1491-1527.

Dee, T.S., Jacob, B.A., Rockoff, J.E., McCrary, J., 2011. Rules and discretion in the evaluation of students and schools: The case of the New York regents examinations. *Columbia Business School Research Paper.*

Enquête sur l'entrée dans la vie adulte des élèves entrés en 6ème en 1995 (EVA) - 2005-2011 - (2011) [fichier électronique], INSEE [producteur], Centre Maurice Halbwachs (CMH) [diffuseur].

Goodman, J., Hurwitz, M., Smith, J., 2015. College access, initial college choice and degree completion. *NBER Working Paper 20996.*

Hamermesh, D.S., Donald, S.G., 2008. The effect of college curriculum on earnings: An affinity identifier for non-ignorable non-response bias. *Journal of Econometrics* 144 (2): 479-491.

Hastings, J.S., Neilson, C.A., Zimmerman, S.D., 2013. Are some degrees worth more than others? Evidence from college admission cutoffs in Chile. *NBER Working Paper 19241.*

Hoekstra, M., 2009. The Effect of Attending the Flagship State University on Earnings: A Discontinuity-Based Approach. *The Review of Economics and Statistics* 91 (4), 717-24.

Hoxby, C., Avery, C., 2014. The Missing One-Offs: The Hidden Supply of High-Achieving Low- Income Students. *Brookings Papers on Economic Activity.* (Spring): 161.

Imbens, G.W., Lemieux, T., 2008. Regression discontinuity designs: A guide to practice. *Journal of Econometrics* 142 (2), 615-35.

Jacob, B.A., Levitt, S.D., 2003. Rotten Apples: An Investigation of the Prevalence and Predictors of Teacher Cheating. *The Quarterly Journal of Economics* 118 (3): 843-877.

Kirkebøen, L., Leuven, E., Mogstad, M., 2016. Field of Study, Earnings, and Self-Selection. *The Quarterly Journal of Economics.*

Lee, D.S, Card, D. 2008. Regression discontinuity inference with specification error. *Journal of Econometrics* 142 (2), 655-674.

Lee, D.S., Lemieux, T., 2010. Regression discontinuity designs in economics. *Journal of Economic Literature* 48 (2), 281-355.

Martorell, P., 2004. Do High School Graduation Exams Matter? A Regression Discontinuity Approach. *UC Berkeley Manuscript.*

Martorell, P., McFarlin Jr., I., 2011. Help or hindrance? The effects of college remediation on academic and labor market outcomes. *The Review of Economics and Statistics* 93 (2): 436-454.

McRary, J., 2008. Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test. *Journal of Econometrics* 142(2), 698-714.

Ou, D., 2010. To Leave or Not to Leave? A Regression Discontinuity Analysis of the Impact of Failing the High School Exit Exam. *Economics of Education Review* 29 (2), 171-186.

Panel d'élèves du second degré, recrutement 1995 - 1995-2011 - (2006) [fichier électronique], DEPP — INSEE [producteur], Centre Maurice Halbwachs (CMH) [diffuseur].

Papay, J.P., Murnane, R.J., Willett, J.B., 2010. The Consequences of High School Exit Examinations for Low-Performing Urban Students: Evidence from Massachusetts. *Educational Evaluation and Policy Analysis.* 32(1): 5-23.

Roderick, M., Nagaoka, J., Coca V., Moeller, E., 2008. From High School to the Future: Potholes on the road to college. *Consortium on Chicago School Research at University of Chicago.*

Saavedra, J., 2009. The Learning and Early Labor Market Effects of College Quality: A Regression Discontinuity Analysis. *Rand Corporation Working Paper.*

Smith, J., Hurwitz, M., Howell, J., 2013. The Full extent of Academic Undermatch. *Economics of Education Review* 32: 247-261.

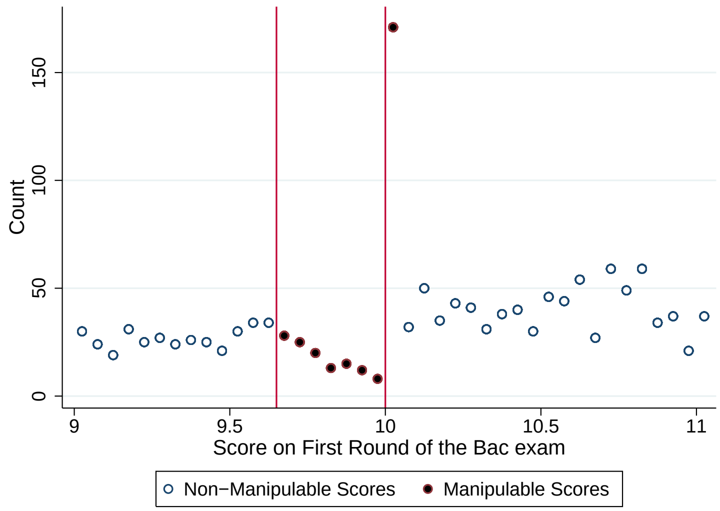
U.S. Department of Commerce, Census Bureau. October, 1967 through 2012. *Current Population Survey.* Washington, DC: U.S. Government Printing Office.

White House Office of Science and Technology Policy, 2015. *President's 2016 Budget 2016 Budget Invests in America's Future: R&D, Innovation, and STEM Education.*

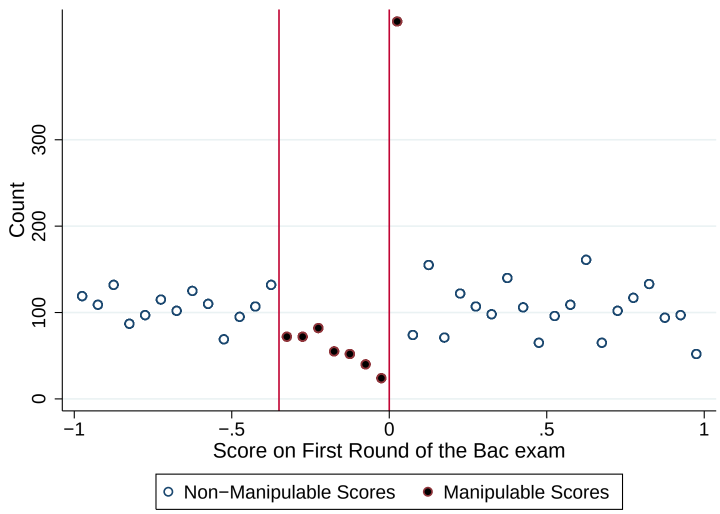
Zimmerman, S., 2014. The Returns to College Admission for Academically Marginal Students. *Journal of Labor Economics* 32 (4): 711-754.

A Figures

Figure 1: Distribution of scores on the first round of the French Baccalaureate exam in the year 2002.



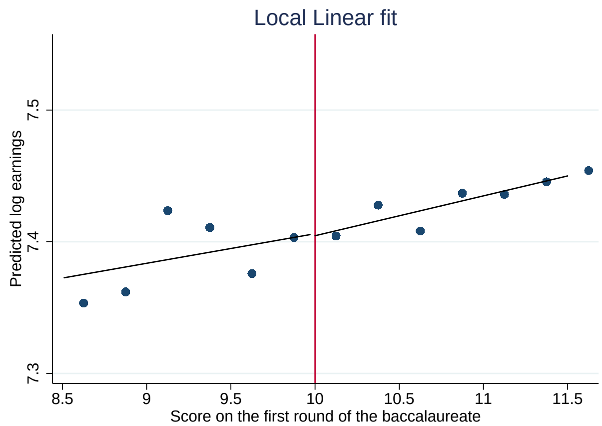
(a) Distribution around the passing threshold.



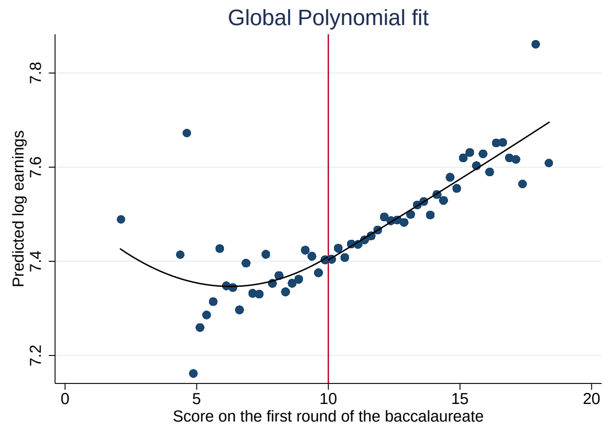
(b) Pooled distribution around all potential cut-offs.

Notes: Sample includes students who took the French Baccalaureate exam in the first round of the year 2002. Counts reported with bin width of 0.05 points. Panel A uses all observations around the passing threshold of 10 points. Panel B pools observations across all cutoffs (8,12,14,16) including the passing threshold of 10.

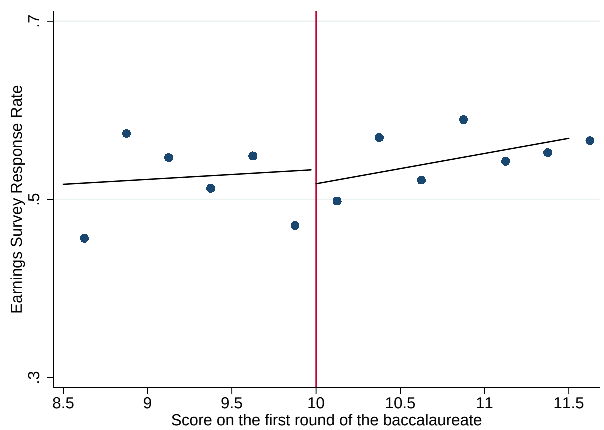
Figure 2: Regression discontinuity design validity checks



(a) Predicted log earnings



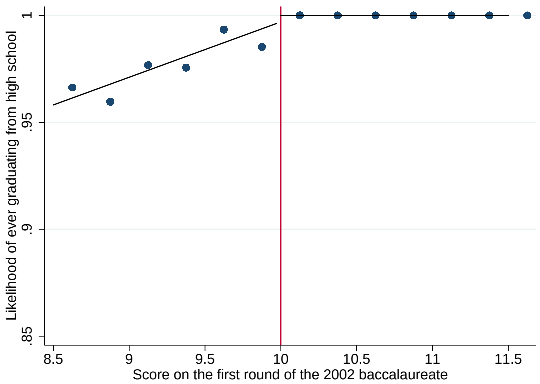
(b) Predicted log earnings



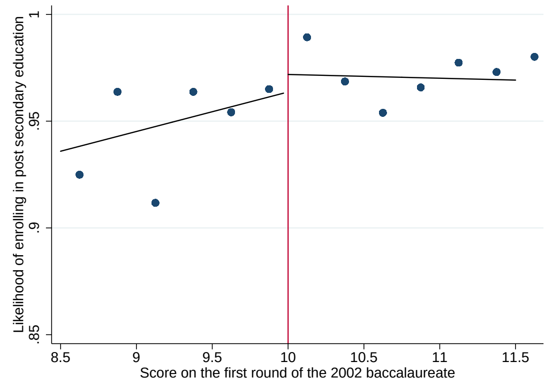
(c) Earnings Survey response rate

Notes: Notes: Sample includes students who took the exam in the first round of the year 2002 and have non missing observations for all predetermined characteristics. These include all variables reported in Table 1 and Appendix Table A1. Circles represent local averages over a 0.25 score range

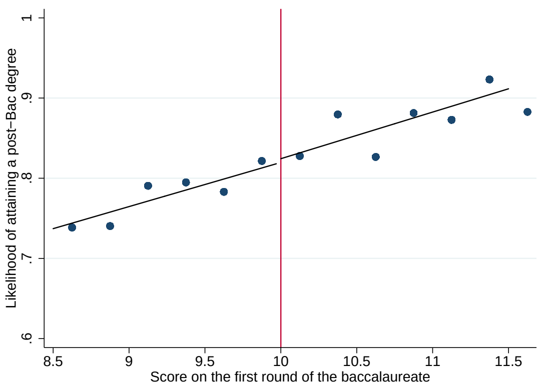
Figure 3: Quantity of education effects based on first round scores of the French Baccalaureate exam



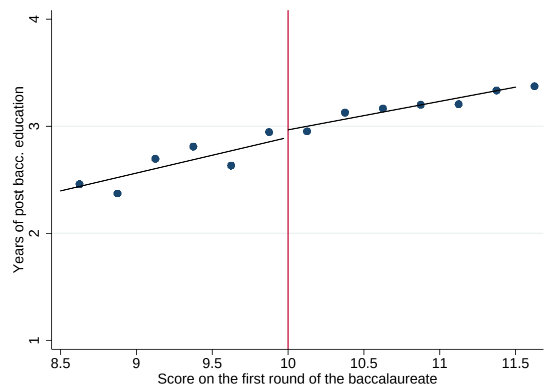
(a) Likelihood of attaining a high school degree



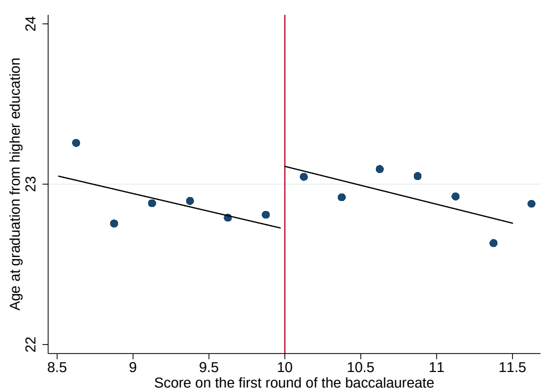
(b) Likelihood of enrolling in a Post-Baccalaureate degree



(c) Likelihood of attaining a Post-Baccalaureate degree



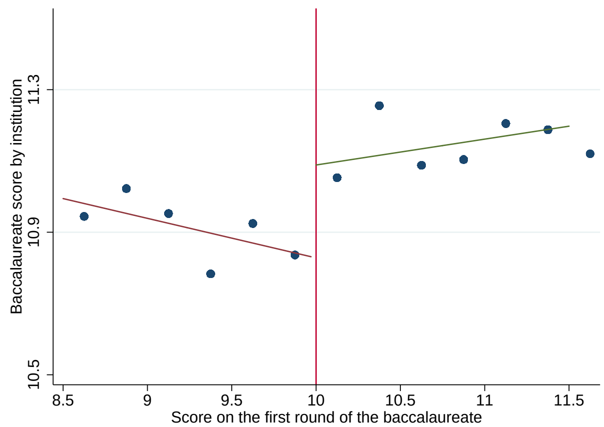
(d) Years of Post-Baccalaureate education



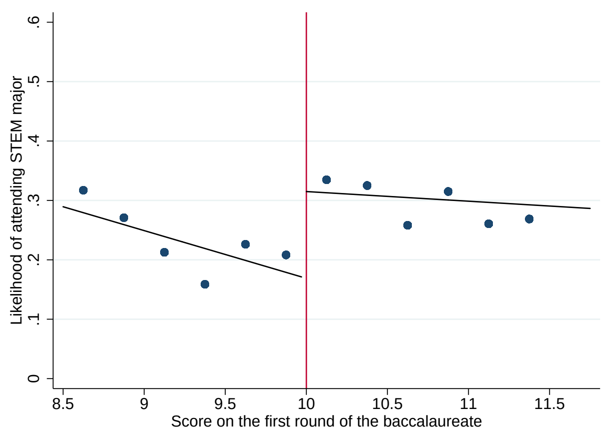
(e) Age at Post-Baccalaureate graduation

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a linear fit on either side of the cutoff.

Figure 4: Quality of education effects based on first round scores of the French Baccalaureate exam



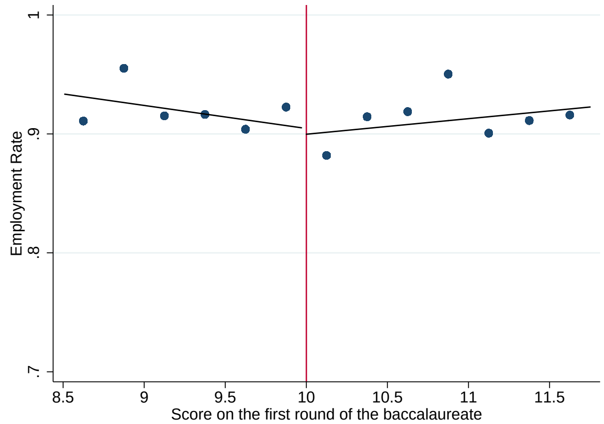
(a) Average Baccalaureate score by attended institution



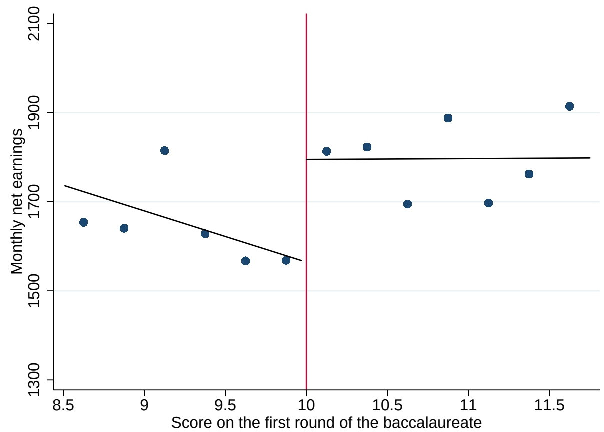
(b) Likelihood of attending STEM major

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a linear fit on either side of the cutoff.

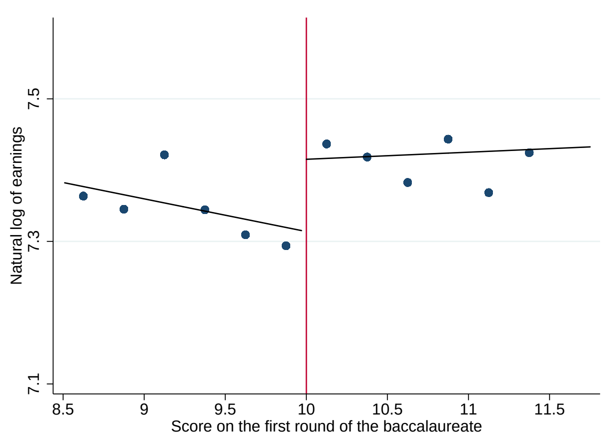
Figure 5: Labor market effects based on first round scores of the French Baccalaureate exam



(a) Likelihood of employment



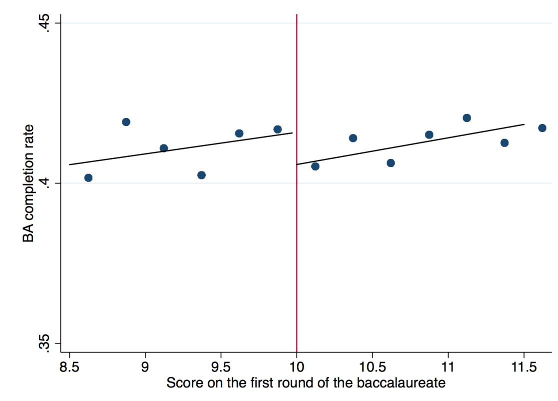
(b) Monthly earnings(in Euros)



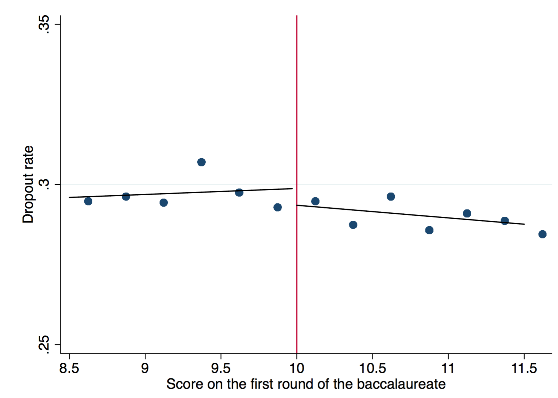
(c) Monthly logged earnings

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a linear fit on either side of the cutoff.

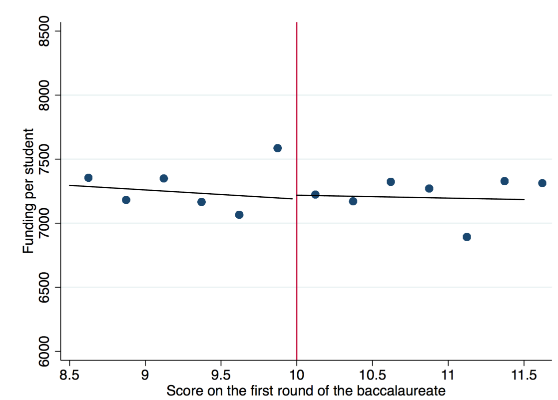
Figure 6: Other university-level quality measures



(a) University-level BA completion rate



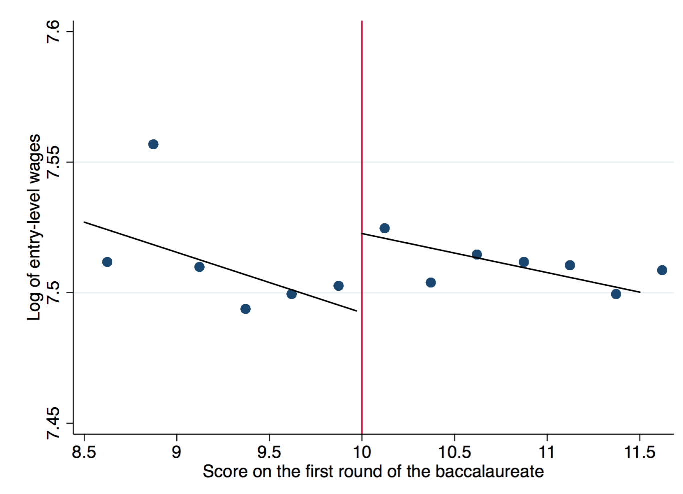
(b) University-level dropout rate



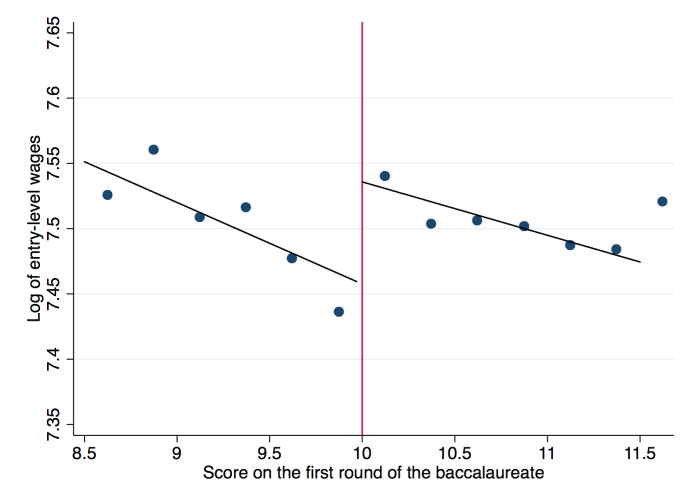
(c) University-level funding per student

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a linear fit on either side of the cutoff.

Figure 7: Earnings at major and university-major level



(a) Major-level log wages



(b) University/major-level log wages

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a linear fit on either side of the cutoff.

B Tables

Table 1: Sample Description (Means) for key variables

	Whole Sample	Marginal Sample	Marginal Donut Sample	Marginal Donut Labor sample
	(1)	(2)	(3)	(4)
Main Education Outcomes				
Score on the Baccalaureate exam	11.19	10.21	10.26	10.28
Passed on the first attempt	0.75	0.69	0.68	0.69
Ever awarded Baccalaureate degree	0.98	0.99	0.99	0.99
Years of Post-Baccalaureate education	3.20	2.98	3.00	3.07
Enrolled in STEM	0.35	0.28	0.28	0.28
Observations	3988	1854	1595	1065
Main Labor Market Outcomes				
Employed in 2011	0.93	0.92	0.92	0.92
Employed in 2012	0.93	0.91	0.91	0.91
Monthly Earnings in 2011 (in Euros)	1660	1554	1568	1568
Monthly Earnings in 2012 (in Euros)	1762	1594	1622	1622
Observations (2011)	2475	1105	950	950
Observations (2012)	2470	1097	947	947
Demographic and academic controls				
Male	0.38	0.36	0.36	0.35
Born in France	0.97	0.97	0.97	0.97
Lives with both parents	0.88	0.88	0.88	0.89
Father is high-skilled	0.59	0.53	0.53	0.52
Grade 11 French exam scores	11.20	10.52	10.55	10.56
Grade 6 Math exam scores	61.50	59.76	59.94	60.40
Grade 9 Brevet exam scores	13.71	13.18	13.19	13.26
Parent thinks student's school				
Helps students with difficulties	0.78	0.77	0.76	0.77
Provides an elite education	0.33	0.34	0.34	0.33
Helps students succeed	0.67	0.67	0.67	0.68
Is as good or better than neighboring schools	0.87	0.87	0.87	0.87
Observations	3338	1538	1322	897

Notes: The marginal sample contains all students scoring 1.5 Bacc points either side of the cutoff.
The marginal donut sample drops all individuals scoring between 9.65 and 10.05 points. The marginal donut labor sample reports statistics for students who have at least one observed wage in the data for the year 2011 or 2012.
The STEM enrollment rate is conditional on enrolling in a postsecondary institution and thus has a slightly smaller sample. Demographic and academic controls summary statistics are conditional on no missing observations among any of the control variables. Population survey weights are used to compute all means.

Table 2: Regression discontinuity design validity checks estimates

Bandwidth	0.5 points	1 point	1.5 points	2 points	2.5 points
	(1)	(2)	(3)	(4)	(5)
Panel A:					
Predicted log earnings	.032*	.030	–.002	.004	–.012
	(.02)	(.03)	(.02)	(.03)	(.03)
Panel B:					
Likelihood of being observed in earnings survey	-.011	–.020	–.016	–.010	–.011
	(.03)	(.04)	(.04)	(.05)	(.04)
Score Polynomial	Zero	One	One	Two	Two

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002 and have non missing observations for all baseline covariates.
Each cell represents a separate regression and the dependent variable is the predicted running variable taken after regressing logged earnings on all baseline covariates.
The treatment variable is 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Standard errors are clustered at the individual level and reported in parentheses.
*** p <0.01 ** p <0.05 * p <0.1

Table 3: Local linear donut RD regressions for "Quantity of Education" variables

	Likelihood of ever graduating high school (1)	Likelihood of enrolling in Post Bacc. degree (2)	Likelihood of having Post Baccc. degree (3)	Years of Post Baccalaureate education (4)	Age at Post Baccalaureate graduation (5)
Panel A:					
Marginal sample	.001	−.005	.014	.018	.689***
	(.02)	(.03)	(.06)	(.24)	(.25)
Panel B:					
Marginal labor force sample	.014	.008	−.004	.143	.698**
	(.01)	(.03)	(.07)	(.28)	(.32)
Panel C:					
High S.E.S	.009	−.035	−.071	−.233	.759**
	(.03)	(.03)	(.08)	(.33)	(.36)
Low S.E.S	.000	.042	.144	.422	.612
	(.02)	(.05)	(.09)	(.35)	(.40)
Panel D:					
Sciences high school concentration	.015	.007	−.104	−.337	.406
	(.02)	(.04)	(.07)	(.29)	(.31)
Non-Sciences high school concentration	−.028	−.026	.232**	.509	.276
	(.03)	(.05)	(.10)	(.33)	(.35)

Notes: The Marginal RD sample contains all students scoring 1.5 Bacc points either side of the cutoff except those scoring between 9.65 and 10.05 points. The labor force sample contains only students who have an observed wage in the data except those scoring between 9.65 and 10.05 points.
Each cell represents a separate regression with educational outcomes as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a linear function of score in which the slope is allowed to vary on either side of the cutoff.
S.E.S = Socio-economic Status.
*** p <0.01 ** p <0.05 * p <0.1. Robust standard errors reported in parentheses.

Table 4: Local linear donut RD regressions for "Quality of Education" variables

	Average peer quality measured in institution Baccalaureate scores (1)	Average peer quality measured in one Standard Deviation of a Baccalaureate score (2)	Likelihood of being in a STEM major (3)
Panel A:			
Marginal sample	.315***	.142***	.234***
	(.11)	(.05)	(.06)
Panel B:			
Marginal labor force sample	.305**	.136**	.192**
	(.14)	(.06)	(.08)
Panel C:			
High S.E.S	.446**	.197**	.198**
	(.17)	(.08)	(.10)
Low S.E.S	.141	.065	.308***
	(.11)	(.05)	(.08)
Panel D:			
Sciences high school concentration	.336***	.152***	.310***
	(.13)	(.06)	(.10)
Non-Sciences high school concentration	.294*	.132*	.047
	(.15)	(.07)	(.04)

Notes: The Marginal RD sample contains all students scoring 1.5 Bacc points either side of the cutoff except those scoring between 9.65 and 10.05 points. The labor force sample contains only students who have an observed wage in the data except those scoring between 9.65 and 10.05 points.
Each cell represents a separate regression with educational outcomes as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a linear function of score in which the slope is allowed to vary on either side of the cutoff.
S.E.S = Socio-economic Status.
*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$. Standard errors clustered by university and reported in parentheses.

Table 5: Local linear donut RD regressions for "Labor Market Outcome" variables

	Employment rates (1)	Net monthly earnings (Euros) (2)	Montlhy logged earnings (3)
Panel A:			
Marginal sample	–.004	268.175***	.118**
	(.04)	(103.58)	(.06)
Panel B:			
High S.E.S	–.056	348.444**	.166*
	(.05)	(148.14)	(.09)
Low S.E.S	.067	248.405	.082
	(.06)	(151.17)	(.08)
Panel C:			
Sciences high school concentration	–.050	400.974***	.194***
	(.04)	(140.37)	(.07)
Non-Sciences high school concentration	.064	23.199	–.025
	(.08)	(136.42)	(.10)

Notes: The Marginal RD sample contains all students scoring 1.5 Bacc points either side of the cutoff except those scoring between 9.65 and 10.05 points.
Each cell represents a separate regression with labor market outcomes as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a linear function of score in which the slope is allowed to vary on either side of the cutoff.
S.E.S = Socio-economic Status.
*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$. Standard errors are clustered at the individual level and reported in parentheses.

Table 6: Regression discontinuity estimates for other university-level quality measures

	BA completion rates (1)	Dropout rates (2)	Funding per student (3)
Donut RD	–.014	–.009	365.104
	(.01)	(.01)	(371.02)
Non-Donut RD	–.010	–.005	30.372
	(.01)	(.01)	(266.67)

Table 7: Regression discontinuity estimates for measures at major and university-major levels

	Major-level log wages (1)	University/major log wages (2)
Donut RD	.039**	.070**
	(.02)	(.03)
Non-Donut RD	.031**	.078***
	(.01)	(.02)

Notes for Tables 6 and 7: The sample used in both tables is the Marginal Sample, i.e. students scoring 1.5 Bacc points on either side of the cutoff. The Marginal Donut RD sample excludes students scoring between 9.65 and 10.05 points.
Each cell represents a separate regression.
All specifications control for a linear function of score in which the slope is allowed to vary on either side of the cutoff.
*** p <0.01 ** p <0.05 * p <0.1. Standard errors are clustered at the individual level and reported in parentheses.

C Online Appendix for "Returns to Education Quality for Low-Skilled Students: Evidence from a Discontinuity"

C.1 Additional Data

This section describes the datasets used in sections 6.2 and 6.3. For all measures, data is only available for the university sector (or *universités*). However, this is not a major concern given that students are shifting within the university system. Some universities merged over time. Unless stated otherwise, we only have information on the final merged university. As described below, data is available for multiple years. For degree completion, dropout rates and funding per student, we take the average over all the different years we observe.

Multidisciplinary and specialized universities The classification of universities into multidisciplinary and specialized is extracted from the dataset "Effectifs d'étudiants inscrits dans les établissements publics sous tutelle du ministère en charge de l'Enseignement supérieur et de la Recherche" provided by the ministry of education's "Open Data" website.[1] Starting with the academic year 2006-2007, this data provides various statistics pertaining to each university including its type—i.e. whether the university is multidisciplinary, specialized in sciences and/or health, specialized in economics and law, or specialized in humanities and social sciences. Between our period of study and 2006, some specialized universities merged into a single multidisciplinary university. In these infrequent cases, we conducted a search on the history of these universities and reclassified them according to their initial specialization; whether that be in sciences and/or health, in economics and law, or in humanities and social sciences. In additional specifications that are available upon request, we verify that our results are insensitive to classifying all merged universities as multidisciplinary (i.e. using the ministry of education's recent classification).

University degree completion and dropout rates These variables are taken from the French ministry of education digests "Parcours et réussite aux diplômes universitaires". These digests report university-level indicators on academic trajectories for students who initially enrolled at a university. These indicators are calculated using data from administrative records. The university-level bachelor's degree (or *licence*) completion and dropout rates are based on students who initially enrolled in universities in the academic years 2007-2008 to 2010-2011 and 2011-2012 to 2013-2014 respectively.[2]

[1] Source: `http://data.enseignementsup-recherche.gouv.fr/explore/dataset/fr-esr-sise-effectifs-d-etudiants-inscrits-esr-public/table/?sort=-rentree`

[2] Source: `http://www.enseignementsup-recherche.gouv.fr/cid81688/parcours-et-reussite-aux-diplomes-universitaires-indicateurs-de-la-session-2012.html`

Funding per student For each university, this variable is constructed by dividing the amount of funding by the total number of enrolled students. Data on the total amount of yearly funding can be found on the ministry of education's website under "Dotations de l'Etat aux universités".[3] The data is available for the years 2009, and 2011 to 2014. Total funding is comprised of funds awarded by the government and other resources such as university enrollment fees.[4] For the years 2011 to 2014, we only have the portion of funds awarded by the government, while total funding is available only for 2009. However, based on the 2009 data, we estimate that on average 91% of total funding is given by the government. The total number of students enrolled in each university is taken from the yearly government education statistics reports "Repères et références statistiques".[5]

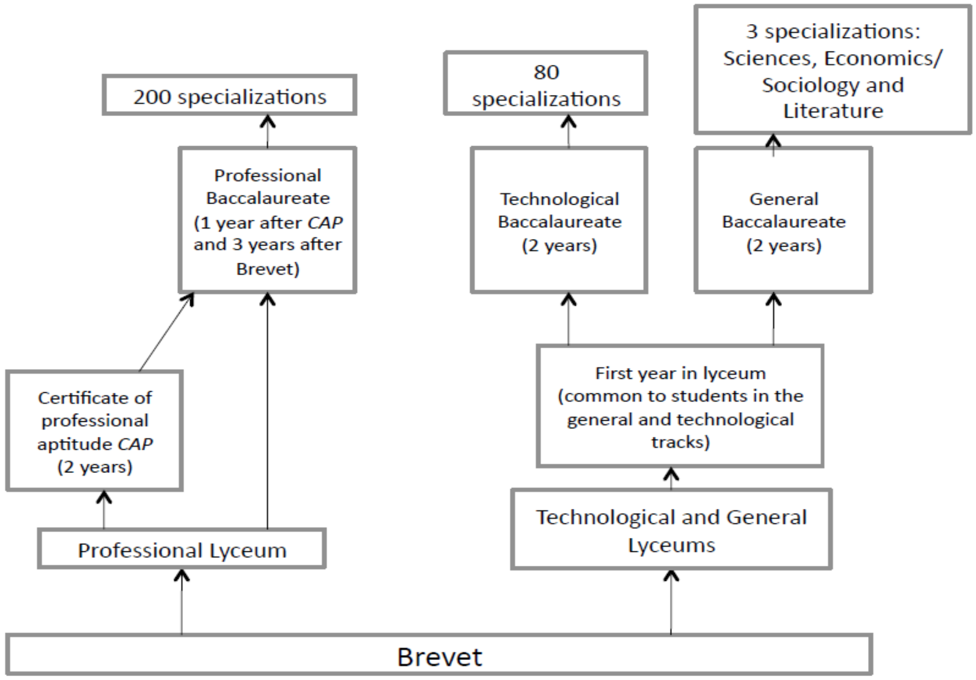
Major and university-major wages These variables are based on the "Insertion professionnelle des diplômés de l'université" surveys conducted by the ministry of education in 2011 and 2012. The surveys report information on labor market outcomes for students who graduated with a master's degree from a specific university and major, 30 months after graduation. When response rates are high enough, the ministry calculates average wages for each major and university-major combination. We do not have average earnings for specific majors but rather for six different categories of majors: law, business and economics; social sciences; humanities and arts; sciences (such as math, physics and chemistry); life sciences (such as biology); health. Finally, each variable is stacked for the years 2011 and 2012.

[3]Source: `http://www.enseignementsup-recherche.gouv.fr/pid25126/les-moyens-de-l-enseignement-superieur.html`

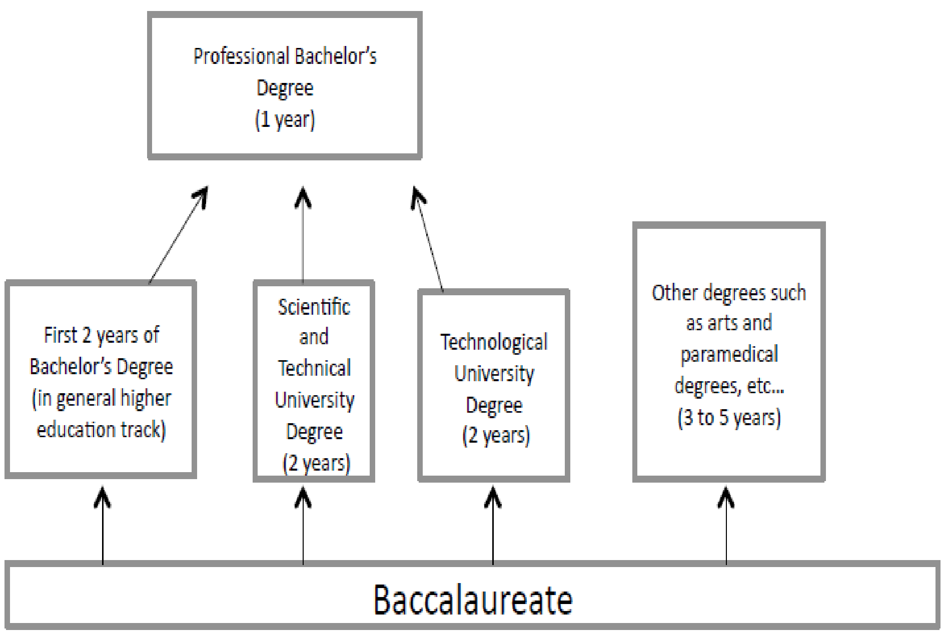
[4]The amount of enrollment fees is the same across all universities and is fixed by the government. Furthermore, it is usually fairly low. For example, for the academic year 2002-2003, the university enrollment fee was €137.05.

[5]Source: `http://www.education.gouv.fr/cid57096/reperes-et-references-statistiques.html`

C.2 High school and Vocational education system in France



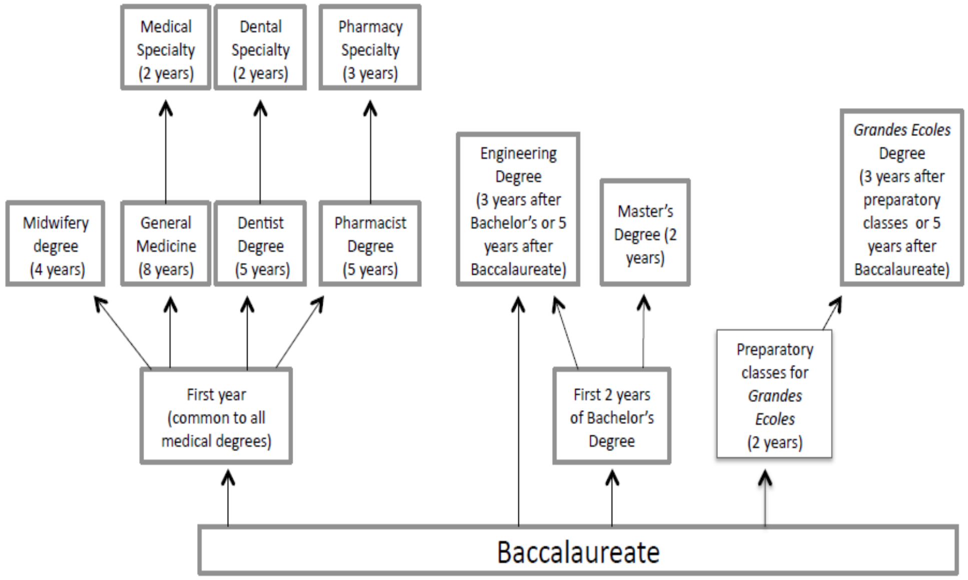
(a) Organization of high school in France



(b) Organization of higher vocational system in France

C.3 Higher education system in France and STEM classifications

s



(a) Organization of higher education in France

1. **STEM designated majors**

   Agricultural sciences
   Economic sciences
   Engineering
   Fundamental sciences and applications
   Life sciences, health and earth sciences
   Materials sciences
   Medical degrees
   Pharmacy
   Sciences and technology

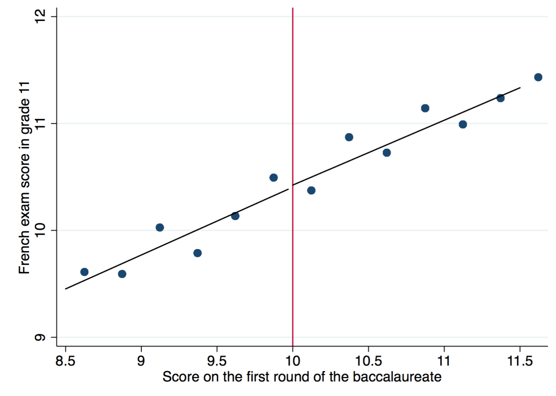
2. **Non-STEM majors**

   Accounting degrees
   Arts
   Higher technical certificate of production
   Higher technical certificate of services
   Languages
   Paramedical degrees
   Political Sciences
   Professional degrees
   Social sciences and humanities degrees
   Social work degrees
   Sports
   Technical degrees

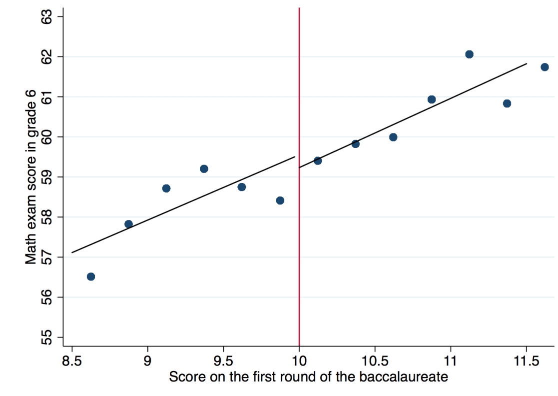
(b) Classification of majors into STEM and non-STEM degrees

C.4 Appendix Figures

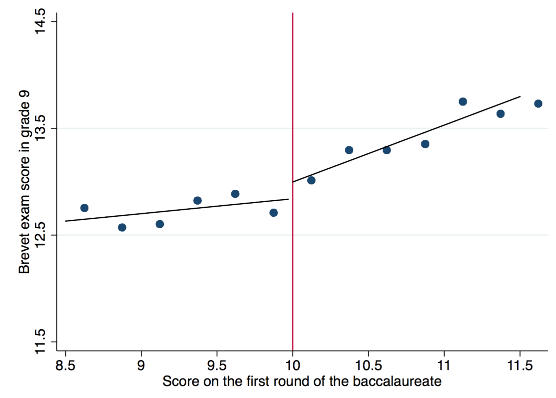
Figure A1: Student's academic performance prior to Baccalaureate exam



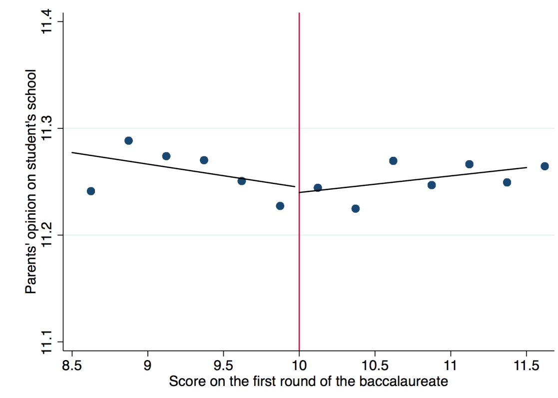
(a) Score on grade 11 French exam



(b) Score on grade 6 math exam



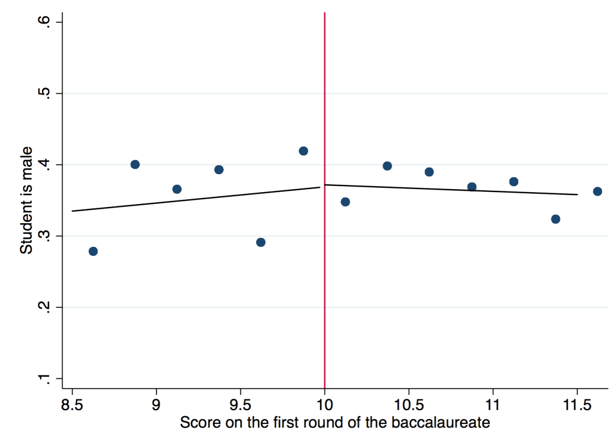
(c) Score on grade 9 Brevet exam



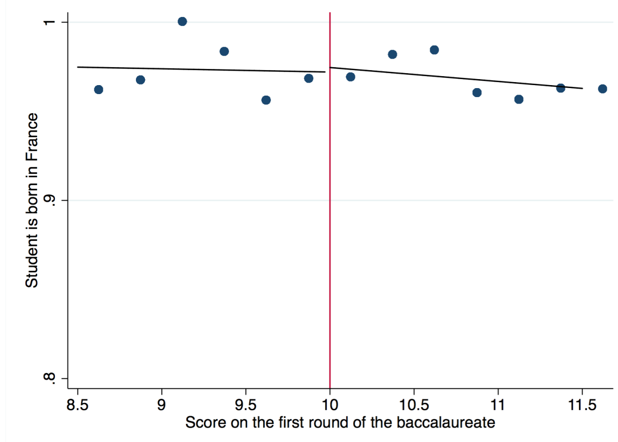
(d) Parent's opinion about student's school

Notes: The variable "Parent's opinion about student's school" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables equal to 1 if parents think that the student's school helps students with diffculties, provides an elite education, helps students succeed and is as good as or better than neighboring schools (see Table A1). Sample includes students who took the exam in the first round of the year 2002.

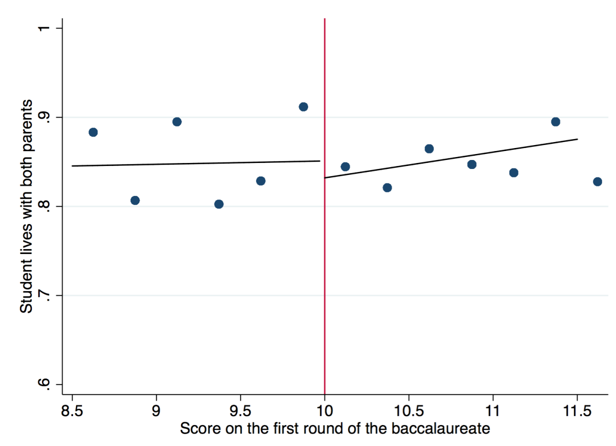
Figure A2: Student's demographic characteristics



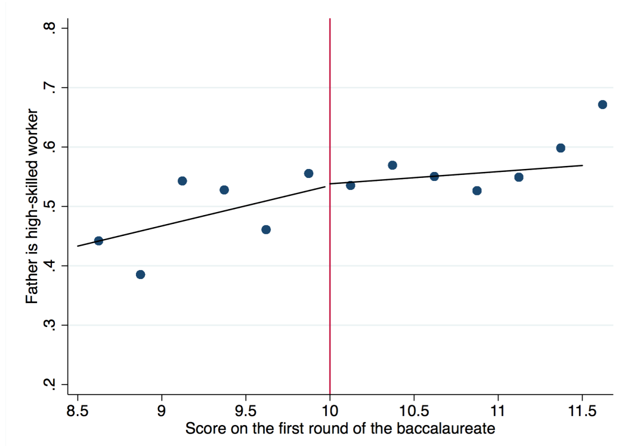
(a) Student is male



(b) Student is born in France



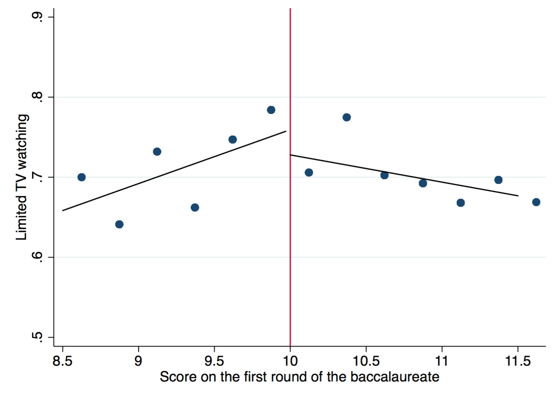
(c) Student lives with both parents



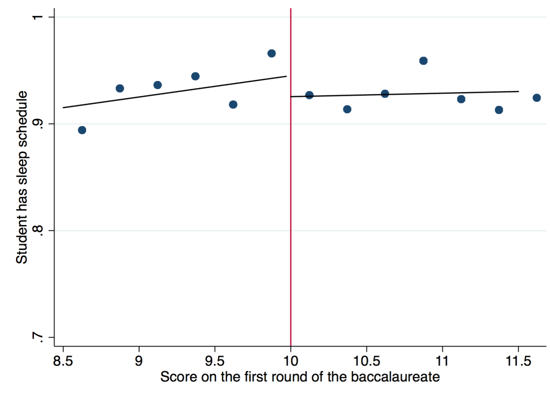
(d) Father is high-skilled

Notes: Sample includes students who took the exam in the first round of the year 2002.

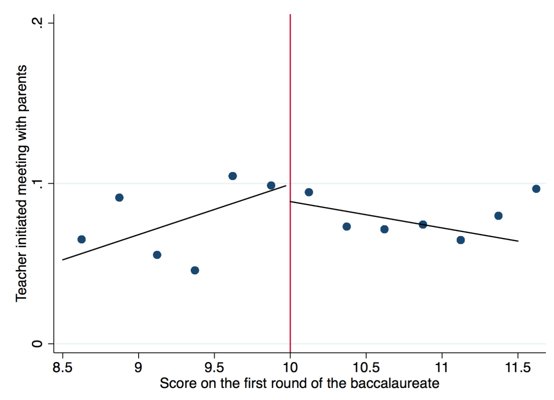
Figure A3: Indicators of parental discipline and student's activities



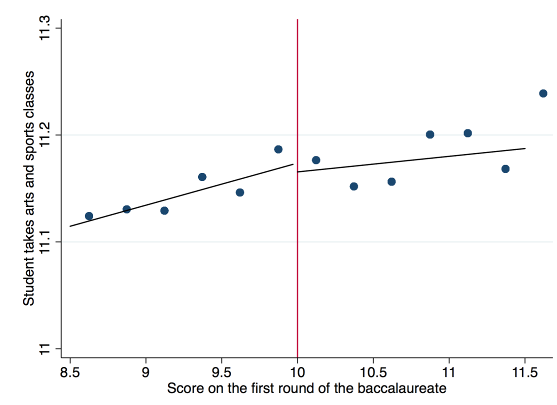
(a) Parent limits TV watching



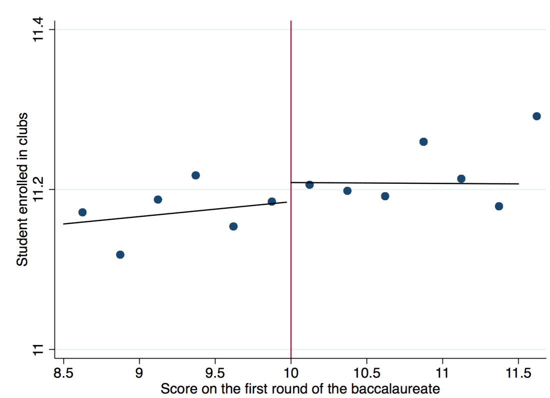
(b) Student has a regular sleep schedule



(c) Teacher initiated meeting with parents



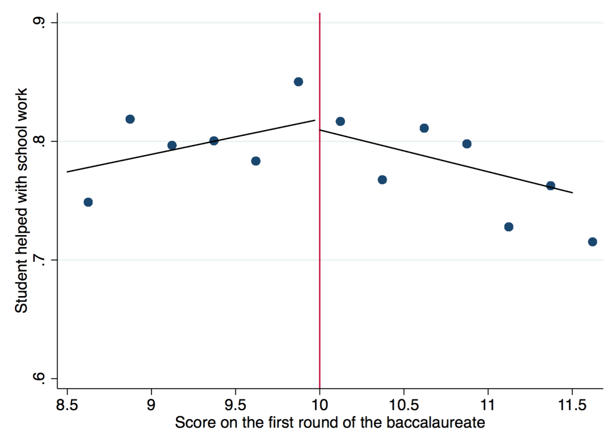
(d) Student regularly takes arts and sports lessons



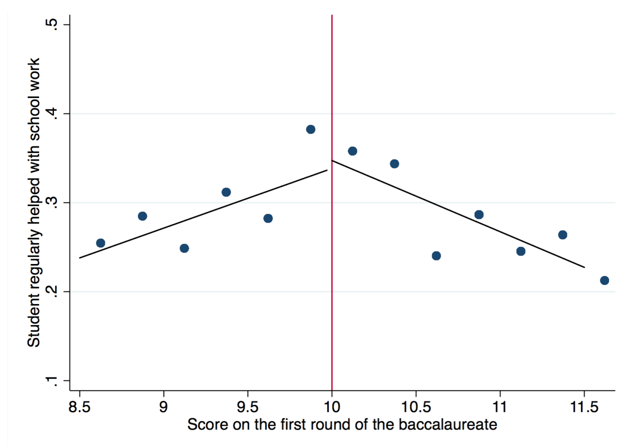
(e) Student is enrolled in clubs

Notes: The variable "Student regularly takes arts and sports lessons" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables indicating whether the student takes regular classes in sports, music or other artistic activities. The variable "Student is enrolled in clubs" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables equal to 1 if the student is a member of sports or other artistic or cultural clubs inside or outside of school, or if he has a library card (see Table A1). Sample includes students who took the exam in the first round of the year 2002.

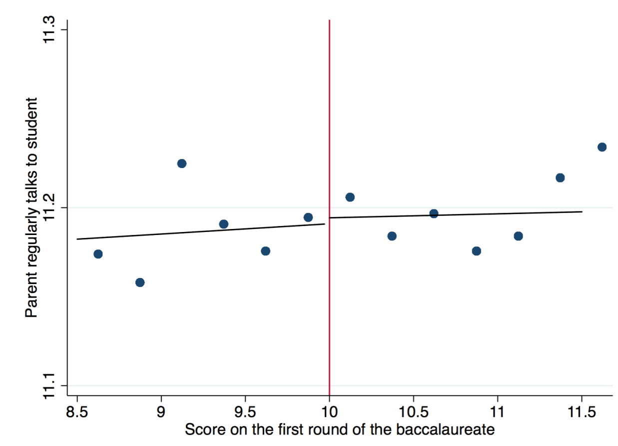
Figure A4: Indicators of parental involvement



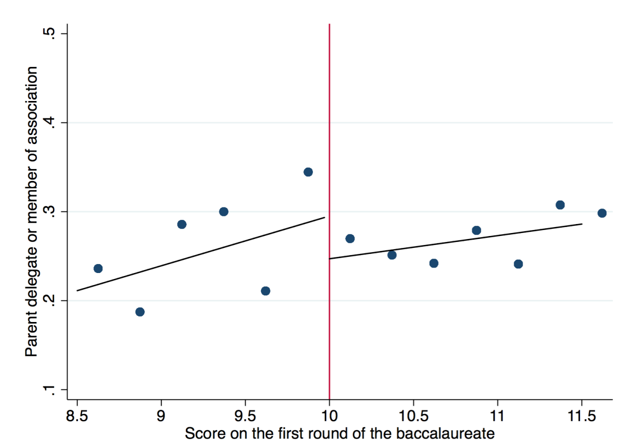
(a) Student is helped with school work



(b) Parent regularly helps student with school work



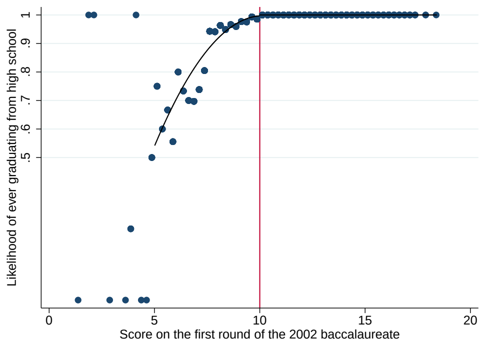
(c) Parents regularly talk to student



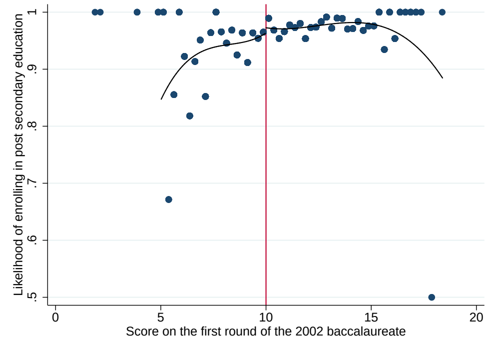
(d) Parent is delegate or member of association

Notes: The variable "Parents regularly talk to student" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables equal to 1 if parents regularly talk to the student about his school work, classmates, school life, teachers, future studies or professional plans (see Table A1). Sample includes students who took the exam in the first round of the year 2002.

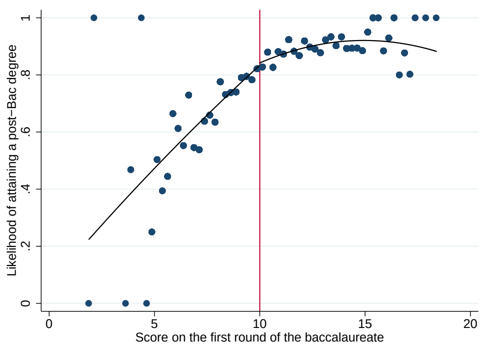
Figure A5: Quantity of education effects based on first round scores of the French Baccalaureate exam (Global Polynomial Graphs).



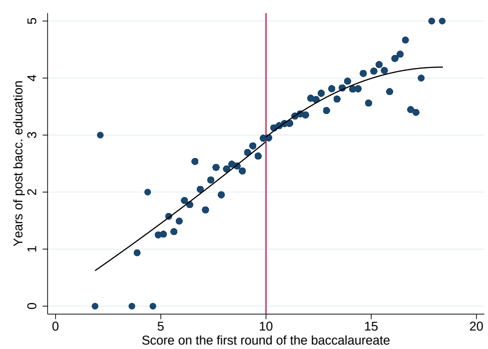
(a) Likelihood of attaining a high school degree



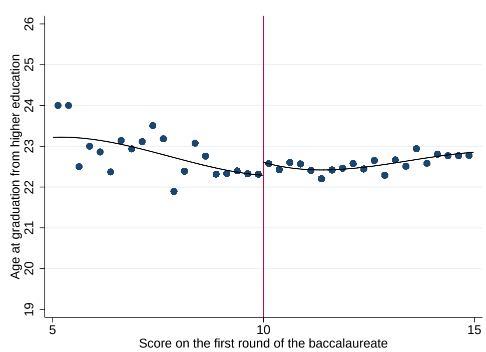
(b) Likelihood of enrolling in a Post-Baccalaureate degree



(c) Likelihood of attaining a Post-Baccalaureate degree



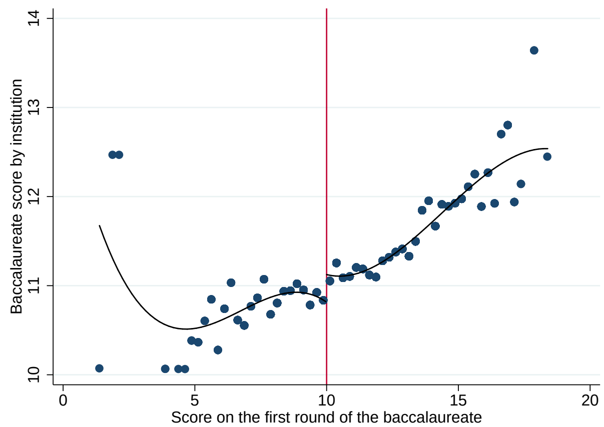
(d) Years of Post-Baccalaureate education



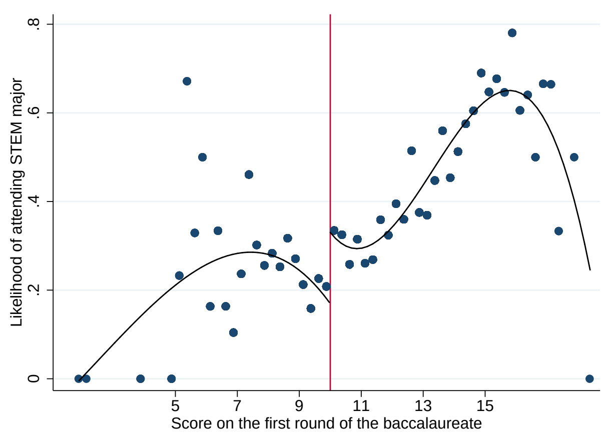
(e) Age at Post-Baccalaureate graduation

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a global polynomial fit on either side of the cutoff.

Figure A6: Quality of education effects based on first round scores of the French Baccalaureate exam (Global polynomial graphs)



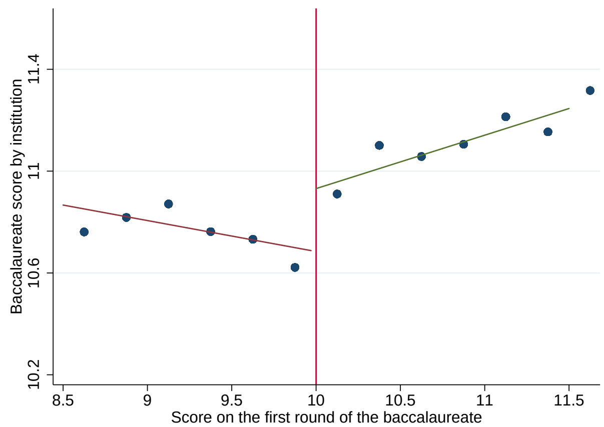
(a) Average Baccalaureate score by attended institution



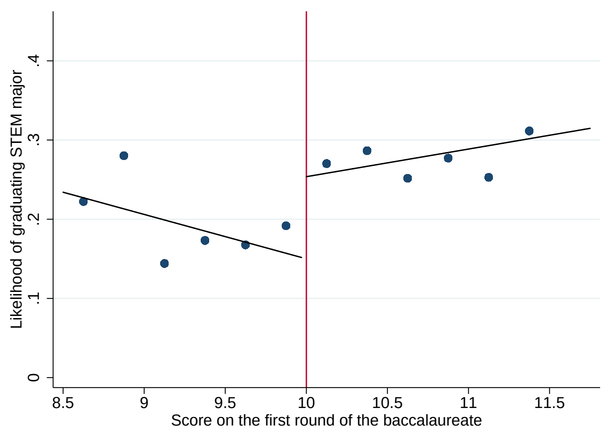
(b) Likelihood of attending STEM major

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a global polynomial fit on either side of the cutoff.

Figure A7: Quality of education 'graduation' effects based on first round scores of the French Baccalaureate exam



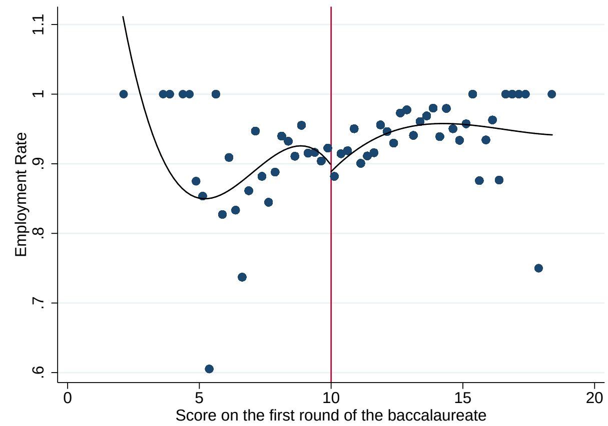
(a) Average Baccalaureate score by graduated institution



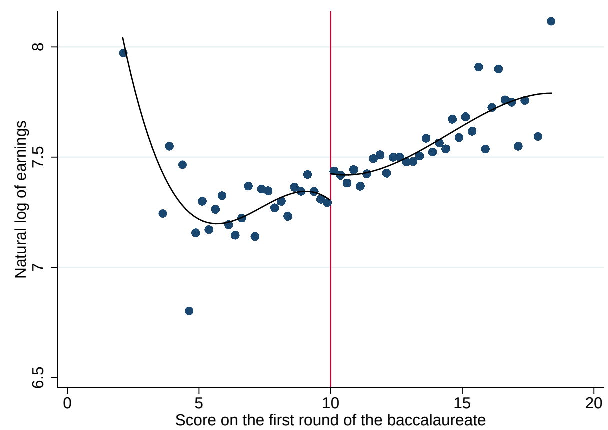
(b) Likelihood of graduating STEM major

Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a linear fit on either side of the cutoff.

Figure A8: Labor market effects based on first round scores of the French Baccalaureate exam (Global Polynomial Graphs)



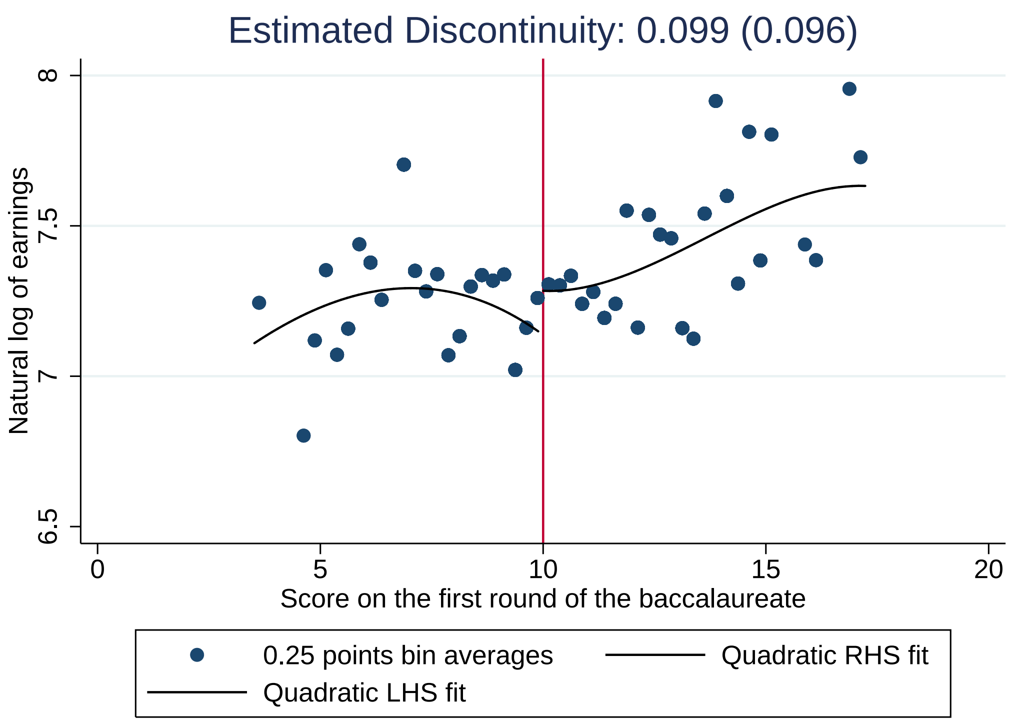
(a) Likelihood of employment



(b) Monthly logged earnings

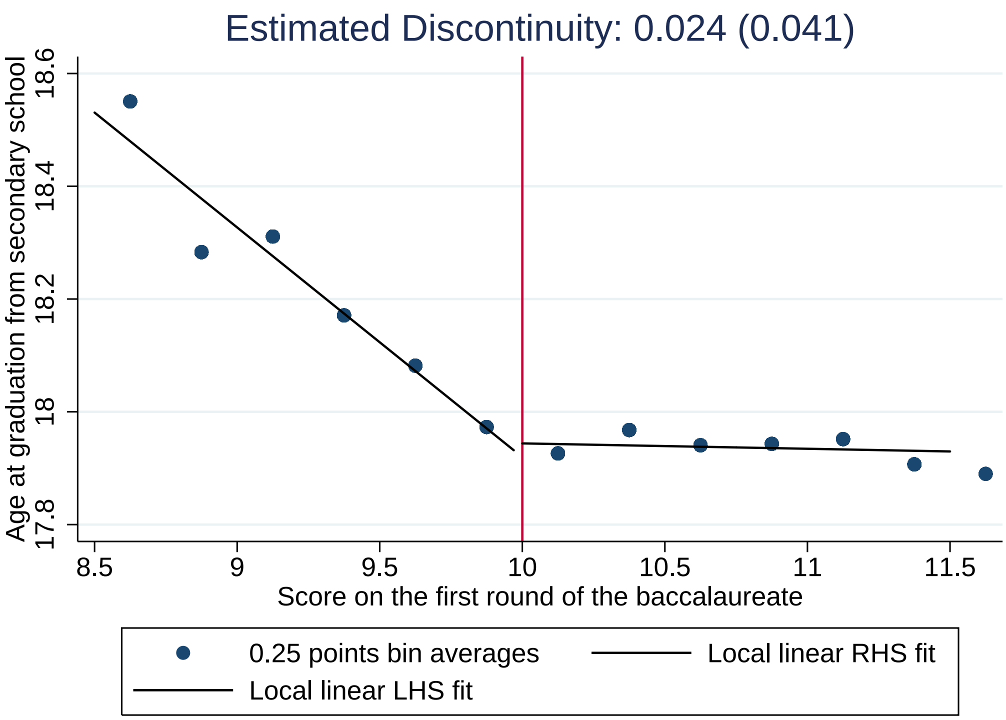
Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Circles represent local averages over a 0.25 score range. All figures are drawn using a global polynomial fit on either side of the cutoff.

Figure A9: Discontinuity in earnings for individuals who never attended college (Global Polynomial Graph)



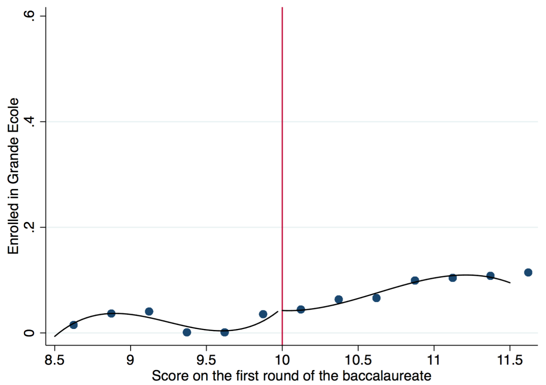
Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Wages are stacked for the two most recent years provided(2011-2012). Standard errors clustered at the individual level and reported in parentheses.

Figure A10: Discontinuity in age at graduation from secondary school

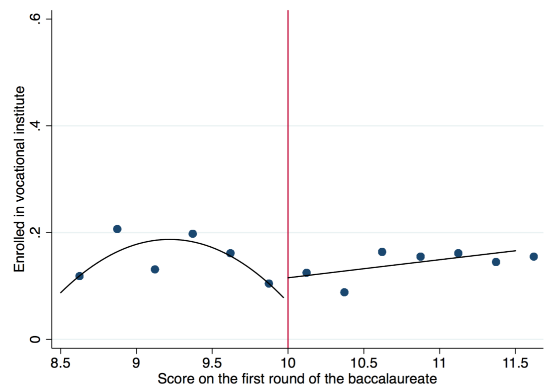


Notes: Sample includes students who took the French Baccalaureate in the first round of the year 2002. Robust standard errors reported in parentheses.

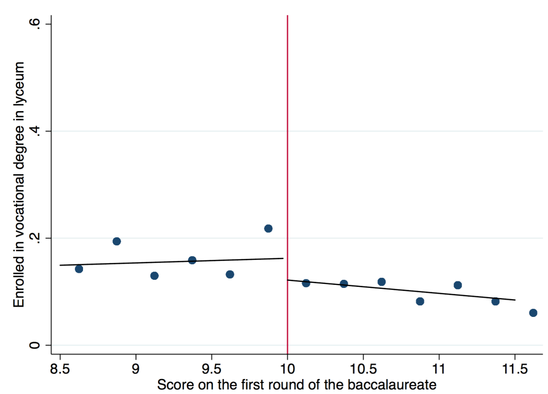
Figure A11: Across-sector shifts



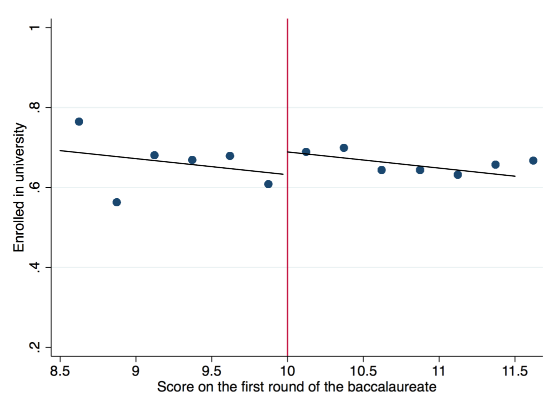
(a) Probability of attending “Grande Ecole” or preparatory classes



(b) Probability of attending vocational institute

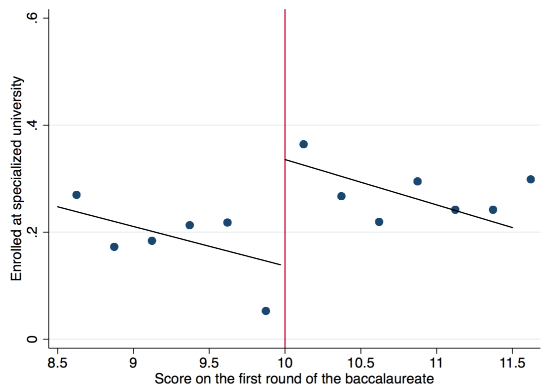


(c) Probability of attending vocational degree in lyceum

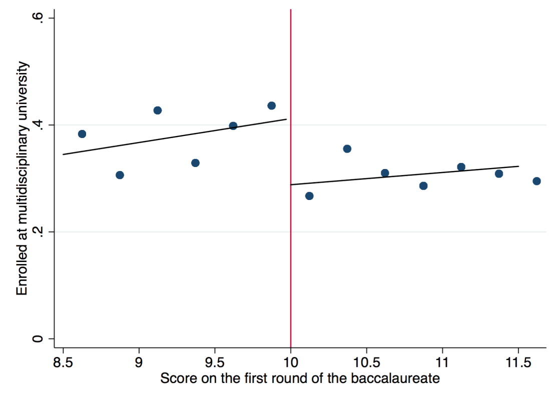


(d) Probability of attending university

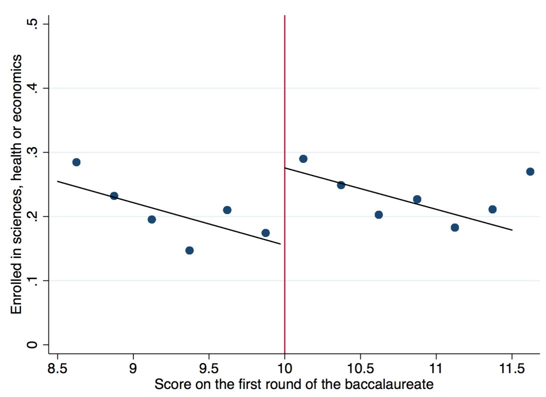
Figure A12: Within-university shifts



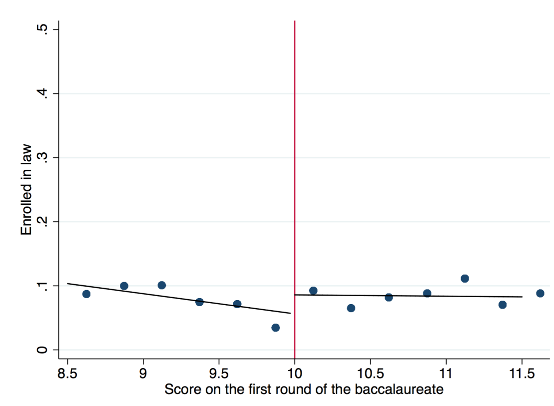
(a) Probability of enrolling in specialized university



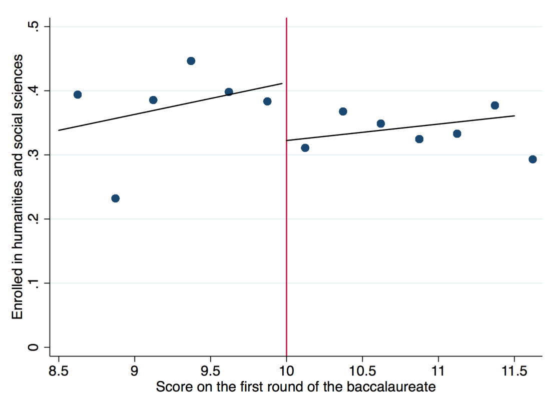
(b) Probability of enrolling in multidisciplinary university



(c) Probability of enrolling in a STEM major



(d) Probability of enrolling in law



(e) Probability of enrolling in humanities and social sciences

C.5 Appendix Tables

Table A1: Summary statistics for baseline covariates

	Whole Sample	Marginal Sample	Marginal Donut Sample	Marginal Donut Labor sample
	(1)	(2)	(3)	(4)
Discipline and activities				
Limited TV watching	0.69	0.70	0.70	0.69
Regular sleep schedule	0.92	0.93	0.93	0.94
Teacher met with parent	0.07	0.07	0.07	0.06
Takes lessons in				
Sports	0.48	0.47	0.47	0.48
Music	0.23	0.19	0.19	0.20
Arts	0.17	0.17	0.17	0.18
Is member of				
School's sports team	0.24	0.24	0.24	0.24
Sports team outside school	0.53	0.53	0.53	0.53
Library	0.56	0.54	0.54	0.55
Other clubs in school	0.22	0.20	0.20	0.21
Music or dance school	0.29	0.25	0.25	0.26
Cultural or social clubs outside school	0.13	0.12	0.12	0.12
Parental involvement				
Helped with school work	0.76	0.81	0.80	0.80
Regularly helped with school work	0.27	0.29	0.29	0.29
Parent regularly talks to student about				
School work	0.70	0.71	0.71	0.71
Classmates	0.61	0.61	0.61	0.61
School life	0.62	0.61	0.61	0.62
Teachers	0.63	0.62	0.63	0.63
Future studies	0.53	0.55	0.55	0.54
Professional plans	0.44	0.47	0.47	0.46
Parent is delegate or member of association	0.28	0.26	0.26	0.27
Observations	3444	1574	1349	921

Notes: The marginal sample contains all students scoring 1.5 Bacc points either side of the cutoff.
The marginal donut sample drops all individuals scoring between 9.65 and 10.05 points. The marginal donut labor sample reports statistics for students who have at least one observed wage in the data for the year 2011 or 2012.
The STEM enrollment rate is conditional on enrolling in a postsecondary institution and thus has a slightly smaller sample. Demographic and academic controls summary statistics are conditional on no missing observations among any of the control variables. Population survey weights are used to compute all means.

Table A2: Regression discontinuity estimates for students' academic performance prior to Baccalaureate exam

Bandwidth	0.5 points	1 point	1.5 points	2 points	2.5 points	5 points
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Grade 11 French exam [Oral+ Written]	.301*	–.098	.020	–.260	–.044	.042
	(.16)	(.24)	(.20)	(.26)	(.24)	(.24)
Panel B:						
Grade 6 Math exam	.936	.579	–.317	–.484	–.077	–.512
	(.76)	(1.13)	(.92)	(1.24)	(1.15)	(1.11)
Panel C:						
Grade 9 Brevet exam	.179	.140	.157	.190	.169	.086
	(.16)	(.24)	(.19)	(.26)	(.23)	(.23)
Panel D:						
Parents' opinion about student's school	–.007	.009	–.005	.018	–.002	–.008
	(.02)	(.03)	(.02)	(.03)	(.03)	(.03)
Score Polynomial	Zero	One	One	Two	Two	Three
Observations (Panels A)	679	1310	1855	2316	2720	3807
Observations (Panel B-C)	587	1116	1591	1980	2334	3275
Observations (Panel D)	536	1030	1447	1805	2124	2990

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002.
Each cell represents a separate regression with baseline covariates as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Robust standard errors reported in parentheses.
The variable "Parent's opinion about student's school" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables equal to 1 if parents think that the student's school helps students with diffculties, provides an elite education, helps students succeed and is as good as or better than neighboring schools (see Table A2).
*** p <0.01 ** p <0.05 * p <0.1

Table A3: Regression discontinuity estimates for student's demographic characteristics

Bandwidth	0.5 points (1)	1 point (2)	1.5 points (3)	2 points (4)	2.5 points (5)	5 points (6)
Panel A:						
Student is male	.038	.002	.003	–.019	–.025	–.030
	(.04)	(.06)	(.05)	(.07)	(.06)	(.06)
Panel B:						
Student is born in France	.014	.023	.003	.011	.005	.011
	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Panel C:						
Student lives with both parents	–.023	–.013	–.019	–.047	–.036	–.023
	(.03)	(.04)	(.04)	(.05)	(.04)	(.04)
Panel D:						
Father is high-skilled	.063	.088	.003	.016	.027	.028
	(.04)	(.07)	(.05)	(.07)	(.06)	(.06)
Score Polynomial	Zero	One	One	Two	Two	Three
Observations (Panels A-B)	679	1310	1855	2316	2720	3807
Observations (Panel C)	637	1228	1742	2178	2566	3611
Observations (Panel D)	618	1187	1690	2113	2488	3481

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002.
Each cell represents a separate regression with baseline covariates as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Robust standard errors reported in parentheses.
*** p <0.01 ** p <0.05 * p <0.1

Table A4: Regression discontinuity estimates for parental discipline and student's activities

Bandwidth	0.5 points (1)	1 point (2)	1.5 points (3)	2 points (4)	2.5 points (5)	5 points (6)
Panel A:						
Parent limits TV watching	–.027	–.020	–.031	–.051	–.088	–.042
	(.04)	(.06)	(.05)	(.06)	(.06)	(.06)
Panel B:						
Student has regular sleep schedule	–.008	–.023	–.020	–.025	–.045	–.035
	(.02)	(.03)	(.03)	(.03)	(.03)	(.03)
Panel C:						
Teacher initiated meeting with parents	–.014	–.038	–.011	–.025	–.026	–.032
	(.03)	(.04)	(.03)	(.04)	(.04)	(.04)
Panel D:						
Student regularly takes arts and sports lessons	.005	–.030	–.008	–.045	–.024	–.007
	(.03)	(.04)	(.03)	(.05)	(.04)	(.04)
Panel E:						
Student enrolled in clubs	.041	.036	.024	–.005	.010	.054
	(.03)	(.05)	(.04)	(.05)	(.04)	(.05)
Score Polynomial	Zero	One	One	Two	Two	Three
Observations (Panels A-D)	637	1228	1742	2178	2566	3611
Observations (Panel E)	625	1191	1681	2100	2475	3462

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002. Each cell represents a separate regression with baseline covariates as the dependent variable and the treatment variable 'scoring above 10 points'. All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Robust standard errors reported in parentheses.
The variable "Student regularly takes arts and sports lessons" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables indicating whether the student takes regular classes in sports, music or other artistic activities. The variable "Student is enrolled in clubs" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables equal to 1 if the student is a member of sports or other artistic or cultural clubs inside or outside of school, or if he has a library card.
*** p <0.01 ** p <0.05 * p <0.1

Table A5: Regression discontinuity estimates for indicators of parental involvement

Bandwidth	0.5 points (1)	1 point (2)	1.5 points (3)	2 points (4)	2.5 points (5)	5 points (6)
Panel A:						
Student is helped with school work	–.004	–.009	–.009	–.025	–.012	.014
	(.03)	(.05)	(.04)	(.05)	(.05)	(.05)
Panel B:						
Parent regularly helps student with school work	.034	–.007	.009	–.005	.016	–.003
	(.04)	(.06)	(.05)	(.07)	(.06)	(.06)
Panel C:						
Parent regularly talks to student	.018	.043*	.003	.007	–.004	.016
	(.02)	(.02)	(.02)	(.03)	(.02)	(.02)
Panel D:						
Parent is delegate or member of association	.009	–.024	–.048	–.052	–.038	–.043
	(.04)	(.06)	(.05)	(.06)	(.06)	(.06)
Score Polynomial	Zero	One	One	Two	Two	Three
Observations (Panels A-C)	637	1228	1742	2178	2566	3611
Observations (Panel E)	633	1209	1707	2137	2516	3526

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002.
Each cell represents a separate regression with baseline covariates as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
The variable "Parents regularly talk to student" is the predicted running variable taken after regressing the Baccalaureate score on dummy variables equal to 1 if parents regularly talk to the student about his school work, classmates, school life, teachers, future studies or professional plans (see Table A2).
Robust standard errors reported in parentheses.
*** p <0.01 ** p <0.05 * p <0.1

Table A6: Regression discontinuity estimates for baseline characteristics at all other important cutoffs

	cutoff = 8	cutoff = 12	cutoff = 14	cutoff = 16
Predicted log earnings	-.03	.02	.002	−.04
	(.43)	(.17)	(.02)	(.04)
Observations	426	1485	868	284

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002 and have non missing observations for all baseline covariates.
Each cell represents a separate regression and the dependent variable is the predicted earnings variable taken after regressing the log earnings on all baseline covariates.
The treatment variable is 'scoring above cutoff=X'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Standard errors are clustered by individual and reported in parentheses.
*** p <0.01 ** p <0.05 * p <0.1

Table A7: 'Donut' type Regression discontinuity estimates for predicted earnings based on all predetermined characteristics

Bandwidth	0.5 points	1 point	1.5 points	2 points	2.5 points
	(1)	(2)	(3)	(4)	(5)
Predicted log earnings					
(Excluding [**9.65-10.05**] region)	.049*	.059	−.006	−.002	−.029
	(.02)	(.04)	(.03)	(.05)	(.04)
Score Polynomial	Zero	One	One	Two	Two
Observations (Excluding 9.65-10.05)	291	757	1123	1482	1809

Notes: Sample includes students who took the French Baccalaureate in the first round of 2002 and have non missing observations for all baseline covariates.
Each cell represents a separate regression and the dependent variable is the predicted earning variable taken after regressing log earnings on all baseline covariates.
The treatment variable is 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Standard errors are clustered by individual and reported in parentheses.
*** p <0.01 ** p <0.05 * p <0.1

Table A8: Regression discontinuity estimates for quantity of education measures

Bandwidth	0.5 points (1)	1 points (2)	1.5 points (3)	2 points (4)	2.5 points (5)
Panel A:					
Likelihood of ever graduating secondary school					
Donut RD	.010	–.001	.001	–.023	–.024
	(.01)	(.02)	(.02)	(.03)	(.02)
Donut RD with controls	.011	.000	–.004	–.025	–.022
	(.01)	(.02)	(.02)	(.03)	(.02)
Non-Donut RD	.010	.003	.003	–.005	–.008
	(.01)	(.01)	(.01)	(.01)	(.01)
Panel B:					
Likelihood of enrolling in a post Baccalaureate degree					
Donut RD	.008	–.046	–.005	–.004	–.020
	(.02)	(.05)	(.03)	(.05)	(.04)
Donut RD with controls	.011	–.035	–.058	–.013	–.020
	(.03)	(.05)	(.09)	(.05)	(.04)
Non-Donut RD	.023	.008	.023	.024	.013
	(.02)	(.03)	(.04)	(.03)	(.02)
Panel C:					
Likelihood of having a post Baccalaureate degree					
Donut RD	.076	.062	.014	–.015	.054
	(.05)	(.09)	(.06)	(.10)	(.09)
Donut RD with controls	.088	.082	.026	.005	.079
	(.06)	(.10)	(.06)	(.10)	(.09)
Non-Donut RD	.050	.019	.005	–.018	.016
	(.04)	(.05)	(.04)	(.06)	(.05)
Panel D:					
Years of Post-Baccalaureate education					
Donut RD	.364*	.130	.018	–.013	.024
	(.19)	(.35)	(.24)	(.39)	(.33)
Donut RD with controls	.317	.106	.050	.083	.086
	(.23)	(.36)	(.23)	(.38)	(.33)
Non-Donut RD	.304**	.125	.071	.051	.070
	(.14)	(.21)	(.17)	(.23)	(.21)
Panel E:					
Age at Post-Baccalaureate graduation					
Donut RD	.343*	.536	.689***	.944**	.758**
	(.21)	(.38)	(.26)	(.42)	(.36)
Donut RD with controls	.558**	.521	.791***	1.263***	.834**
	(.25)	(.40)	(.26)	(.42)	(.36)
Non-Donut RD	.206	.202	.391*	.336	.332
	(.16)	(.25)	(.20)	(.27)	(.25)
Score Polynomial	Zero	One	One	Two	Two
Observations (Donut)	419	1050	1595	2056	2460
Observations (Non-Donut)	679	1310	1855	2316	2720

Notes: Each cell represents a separate regression with educational outcomes as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Controls include exam specialization fixed effects, date of birth, regional controls, gender, socioeconomic status, scores on the Brevet examination, scores on the French portion of the Baccalaureate taken in grade 11 and scores in the grade 6 national assessment exam in Mathematics.
*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$. Robust standard errors reported in parentheses.

Table A9: Regression discontinuity estimates for quality of education measures

Bandwidth	0.5 points (1)	1 points (2)	1.5 points (3)	2 points (4)	2.5 points (5)
Panel A:					
Average peer quality measured					
in institution Baccalaureate scores					
Donut RD	.256***	.342**	.315***	.441**	.363***
	(.09)	(.14)	(.11)	(.18)	(.13)
Donut RD with controls	.268***	.299**	.305***	.381**	.284***
	(.08)	(.12)	(.08)	(.15)	(.11)
Non-Donut RD	.226***	.246**	.258***	.307**	.275***
	(.07)	(.10)	(.09)	(.12)	(.10)
Panel B:					
Average peer quality measured					
in one Standard Deviation					
of a Baccalaureate score					
Donut RD	.110***	.151**	.142***	.196**	.152**
	(.04)	(.07)	(.05)	(.08)	(.06)
Donut RD with controls	.115***	.132**	.138***	.171**	.111**
	(.04)	(.05)	(.04)	(.07)	(.05)
Non-Donut RD	.097***	.110**	.117***	.138**	.117***
	(.03)	(.05)	(.04)	(.05)	(.04)
Panel C:					
Likelihood of being					
in a STEM major					
Donut RD	.133**	.207**	.234***	.279***	.267***
	(.05)	(.09)	(.06)	(.10)	(.09)
Donut RD with controls	.119**	.141*	.206***	.225**	.227***
	(.05)	(.08)	(.06)	(.10)	(.08)
Non-Donut RD	.105***	.122**	.158***	.148**	.158***
	(.04)	(.06)	(.05)	(.06)	(.06)
Score Polynomial	Zero	One	One	Two	Two
Observations (Donut)	415	1040	1579	2032	2429
Observations (Non-Donut)	630	1255	1794	2247	2644

Notes: Each cell represents a separate regression with educational outcomes as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Controls include exam specialization fixed effects, date of birth, regional controls, gender, socioeconomic status, scores on the Brevet examination, scores on the French portion of the Baccalaureate taken in grade 11 and scores in the grade 6 national assessment exam in Mathematics.
*** p <0.01 ** p <0.05 * p <0.1. Standard errors are clustered at the university level and reported in parentheses.

Table A10: Regression discontinuity estimates for labor market outcome measures

Bandwidth	0.5 points (1)	1 points (2)	1.5 points (3)	2 points (4)	2.5 points (5)
Panel A: Employment rates					
Donut RD	–.023	–.040	–.004	–.012	.038
	(.04)	(.06)	(.04)	(.07)	(.06)
Donut RD with controls	–.015	–.028	.004	.011	.057
	(.04)	(.06)	(.04)	(.07)	(.06)
Non-Donut RD	–.019	–.029	–.008	–.015	.009
	(.02)	(.03)	(.03)	(.04)	(.03)
Panel B: Net monthly earnings					
Donut RD	281.567***	486.799***	268.175***	450.419***	303.729**
	(86.42)	(155.24)	(103.58)	(162.36)	(137.88)
Donut RD with controls	376.875***	467.374***	283.689***	460.548***	317.032**
	(112.35)	(159.15)	(103.18)	(160.47)	(135.66)
Non-Donut RD	250.293***	343.572***	252.031***	340.586***	279.548***
	(62.59)	(92.57)	(72.57)	(96.56)	(87.96)
Panel C: Monthly logged earnings					
Donut RD	.127***	.218***	.118**	.189**	.120
	(.05)	(.08)	(.06)	(.10)	(.08)
Donut RD with controls	.162***	.196**	.123**	.187**	.130*
	(.05)	(.08)	(.06)	(.09)	(.08)
Non-Donut RD	.126***	.180***	.128***	.176***	.142***
	(.04)	(.06)	(.04)	(.06)	(.05)
Score Polynomial	Zero	One	One	Two	Two
Stacked Observations (Donut)	440	1133	1720	2261	2732
Stacked Observations (Non-Donut)	711	1406	1993	2534	3005

Notes: Each cell represents a separate regression with labor market outcomes as the dependent variable and the treatment variable 'scoring above 10 points'.
All specifications control for a flexible polynomial of score in which the slope is allowed to vary on either side of the cutoff.
Controls include exam specialization fixed effects, date of birth, regional controls, gender, socioeconomic status, scores on the Brevet examination, scores on the French portion of the Baccalaureate taken in grade 11 and scores in the grade 6 national assessment exam in Mathematics.
*** p <0.01 ** p <0.05 * p <0.1. Standard errors clustered by individual and reported in parentheses.

Table A11: Regression discontinuity estimates for across sector shifts

	Grande Ecole	Vocational institute	Vocational degree in lyceum	University
	(1)	(2)	(3)	(4)
Donut RD	.063	−.093	−.016	.050
	(.08)	(.09)	(.05)	(.07)
Non-Donut RD	−.005	.046	−.041	.057
	(.02)	(.04)	(.04)	(.05)

*** p <0.01 ** p <0.05 * p <0.1.

Table A12: Regression discontinuity estimates for within-university sector shifts

	Specialized university	Multidisciplinary university	Sciences, health economics and business	Law and political sciences	Humanities, arts and social sciences
	(1)	(2)	(3)	(4)	(5)
Donut RD	.144**	−.062	.195***	−.000	−.128*
	(.07)	(.07)	(.06)	(.04)	(.07)
Non-Donut RD	.199***	−.124**	.143***	.030	−.090*
	(.04)	(.05)	(.04)	(.03)	(.05)

*** p <0.01 ** p <0.05 * p <0.1.

Table A13: IV versus OLS log earnings estimates of STEM enrollment and Peer Quality

Log Earnings	OLS	OLS—Controlling for test scores	2SLS
	(1)	(2)	(3)
Peer Quality (Measured in One Standard Deviation)	.04***	.024***	.383
	(.003)	(.07)	(.262)
Likelihood of STEM enrollment	.185***	.142***	.635**
	(.012)	(.012)	(.276)

Notes: All estimates use the marginal donut RD as the sample. The outcome variable is log of earnings stacked for the years 2011 and 2012.
We instrument peer quality and STEM enrollment with the jump at the threshold in order to get 2SLS estimates.
Clustered standard errors reported in parentheses.
*** p <0.01 ** p <0.05 * p <0.1.