# Adverse Impacts of Supply Restrictions in Secondary Schooling*

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**Abstract**

Many students are restricted from pursuing their preferred educational paths due to, e.g., supply restrictions and meritocratic admission policies. In this paper, we document negative effects on well-being for students who are denied admission to their preferred upper secondary institution and educational track. Using a regression discontinuity design, novel data on 172,770 student applications, and difficult-to-predict GPA thresholds for grade-based admission in the Norwegian setting, we find causal evidence showing that students who are denied admission to their preferred track-school combination are significantly more likely to receive a mental health diagnosis, to reapply to a first-year program a year after their first application, and to experience delays in their school progression. A key finding is that the negative impacts of rejection depend on track-level supply restrictions at the regional level. By dividing the sample into quartiles based on the share of rejected students who enroll in a non-preferred school but in their preferred field, we find that our effects are driven by the regions in which students have the fewest school options within their preferred track.

**Keywords:** Education, Mental Health, Public Policy, Regional Economics, RDD, School Choice

**JEL Classification:** I20, I31, H75, R10

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# 1 Introduction

The choice of upper secondary schooling, as well as deciding which institution to attend and which education track (general versus vocational) to pursue, is arguably the most important choice in adolescence. Not only can such a choice have significant impacts on labor market outcomes (see e.g. Brunner *et al.*, 2019; Silliman and Virtanen, 2022; Birkelund and van de Werfhorst, 2022), but it can also potentially affect individuals' overall well-being and quality of life. Despite the importance of upper secondary schooling choices, many students are restricted from pursuing their preferred educational field or attending their school of choice due to capacity constraints and other supply restrictions. Yet, we know little about how adolescents cope with being restricted from their preferred educational choices, and it is unclear whether the school or the educational track are more important for students' well-being.

In this paper, we identify the impact of being denied admission to one's preferred upper secondary institution and track on mental well-being.[1] The schooling choice in our setting is the choice between various upper secondary tracks (academic versus various vocational options) and schools offering each track, as determined by students' preference rankings.[2] Our empirical approach leverages novel data on 172,770 applications from centralized admission systems in Norwegian upper secondary schooling, which assigns students to tracks and schools based on stated preferences and their grade point averages (GPA) from lower secondary school.[3] We use these data on educational preferences in a regression discontinuity design (RDD), which exploits difficult-to-predict grade-based admission thresholds to effectively randomize acceptance versus rejection of students into their preferred track-school combination. Other than small differences in grades, accepted and rejected students close to the thresholds are, in expectation, identical in terms of other characteristics, which we use to identify the causal effects of non-admission. As nearly all students in our setting enroll in upper secondary education, the outside options for students who are rejected from their preferred choice are to pursue either their preferred track at another school or another track at the same or another school. Meanwhile, the within-track options available to each student differ between school regions, and track-level supply restrictions are more prevalent in less densely populated areas. This regional heterogeneity allows us to identify the relative importance of track-level supply restrictions in driving the adverse impacts of being rejected from a preferred track-school combination.

We present four key findings. First, we have a highly significant first-stage: scoring below (versus above) the GPA cutoff of one's preferred track-school combination reduces the likelihood of

[1] We proxy mental well-being through GP-registered diagnoses of mental health symptoms or disorders.

[2] Students rank three educational tracks as priority 1—3, and up to three schools within each track.

[3] These applications cover half of all Norwegian students enrolled in our sample period of 2011-2016.

enrollment in that track and school by 28.7 percentage points (114.6%). Second, being restricted from attending one's preferred education has a strong negative impact on well-being, as proxied by use of mental health care services. Compared to accepted students, rejected students are 9.4 percentage points (38%) more likely to consult their GP for reasons related to mental health in the three years following upper secondary enrollment. Third, we show that students have strong preferences for their preferred track-school combinations, where rejected students are more likely both to apply to and enroll in a first-year program in the year following their initial application. As a result, rejection from one's preferred school and track causes delays in school progression. Fourth, the negative effects we identify seem to be driven by track restrictions rather than school restrictions, as the effects are much stronger in school regions that are more capacity-constrained concerning students' preferred tracks.

Our findings provide new insights into the adverse effects of educational supply restrictions (Bleemer and Mehta, 2021), which can be driven by (a combination of) capacity constraints, thin schooling markets, market failure, or regulatory interventions. A key takeaway for policymakers is that easing supply restrictions, by increasing the number of students allotted to oversubscribed tracks, could lead to significant welfare gains. This is particularly true in our setting, as track-level supply restrictions mainly occur within the vocational tracks associated with higher future labor market earnings.

Through our regional analysis, we highlight the importance of considering the counterfactual of admission, which is determined by the outside options available to students, when assessing the impact of admission decisions. Supply restrictions in various schooling regions determine the outside options of students, which is crucial for researchers to consider when studying multiple local education markets. Furthermore, we argue that focusing on school rejection, rather than admission, may provide a more intuitive understanding of the negative effects of supply restrictions on mental health and school progression. While the enrollment outcomes for accepted students are predictable and comparable across schooling regions, the outcomes for rejected students are highly diverse and depend on local options. In other words, focusing on rejected rather than accepted students fixes a more stable counterfactual outcome for comparison while allowing the different outcomes of rejected students to be analyzed as effects of treatment.

This study contributes to the existing literature on the effects of the choice of school and education type among students in secondary education.[4] This literature primarily focuses on the returns of different educational types and of more selective schools in terms of educational and labor market outcomes. Concerning the returns to various education types, while previous research

[4] A related literature explores the causal impact of enrolling in different fields of study in higher education (Altonji *et al.*, 2012; Hastings *et al.*, 2013; Kirkeboen *et al.*, 2016).

finds positive effects on on-time graduation (Dougherty, 2018; Hemelt *et al.*, 2019), it is often argued that vocational secondary education may be beneficial in the short term but adverse in the long term (Krueger and Kumar, 2004; Brunello and Rocco, 2017; Hampf and Woessmann, 2017; Hanushek *et al.*, 2017). However, recent causal evidence also finds positive effects in the longer term (Brunner *et al.*, 2019; Silliman and Virtanen, 2022). Regarding the returns to more selective schools, previous studies have found positive effects on educational outcomes in some settings (Hastings and Weinstein, 2008; Jackson, 2010, 2013; Pop-Eleches and Urquiola, 2013; Butikofer *et al.*, 2020) but not in others (Dobbie and Fryer Jr, 2014; Abdulkadiroğlu *et al.*, 2014, 2017). Our findings concerning the adverse impacts of rejection from one's preferred track-school combination on mental well-being have important implications for interpreting the education and labor market returns found in previous studies. Because adolescent mental health is strongly linked to adult labor market outcomes (Lundborg *et al.*, 2014), RDD studies comparing the labor market differences between students of various schools or education types will not identify the "pure" causal labor market returns, but the combined effect of such returns and the negative effects stemming from rejection.

In terms of mental health outcomes, our study corroborates the findings of Butikofer *et al.* (2020), who examined the mental health impact of school acceptance versus rejection among students in Norway's largest school regions (Oslo and Bergen).[5]. Like us, they found no significant impact during upper secondary school, but they did find that acceptance into a more selective school leads to higher school completion and enrollment rates in higher education, as well as a lower risk of mental health diagnosis after graduation from upper secondary school. Our main contribution relative to Butikofer *et al.* (2020) is that our more comprehensive data allows us to investigate the relative importance of track versus school restrictions on students' mental well-being. This is crucial, as the negative impact of rejection is more severe for students who are restricted from pursuing their preferred track than for those who have the option of pursuing their preferred track at another school. In addition, our study is unique in that we have access to actual data on student application preferences.

Finally, our study also contributes to the broader literature on the relationship between education and outcomes related to mental well-being. In a systematic review, Esch *et al.* (2014) conclude there is widespread academic consensus on a positive association between mental health and educational attainment. Furthermore, the relationship is reciprocal in that mental health affects educational attainment and vice versa (Quiroga *et al.*, 2013). Self-reported mental health

[5]The school regions of Oslo and Bergen differ significantly from the general population in terms of students' socio-economic characteristics and, importantly, of the availability of within-track options. Furthermore, students in these regions are more likely to enroll in the general academic track compared to the overall population

issues, such as depression or anxiety, are a strong predictor of dropout in upper secondary education (see, e.g., Bowman *et al.*, 2017 or Andersen *et al.*, 2021). Most studies focusing on causal identification find that increased schooling improves future outcomes related to mental well-being (see, e.g., Frisvold and Golberstein, 2011; Crespo *et al.*, 2014; Dursun and Cesur, 2016). However, education type seems to affect health behavior more than the length of education does (Galama *et al.*, 2018). Regarding secondary education type, Böckerman *et al.* (2021) finds that postponing the tracking of Finnish students into vocational and academic schools from ages 11 to 16 years had no discernible effects on mental health-related hospitalization or death. Regarding school choice, previous research finds that attending a more selective college strongly predicts health behavior and outcomes, such as smoking and obesity (Fletcher and Frisvold, 2011, 2014) . We contribute to this broader literature by providing clear causal evidence of the effects of school and education type on mental well-being while in school, showing that being rejected from a preferred education choice can have adverse impact on mental well-being in regions with track-level supply restrictions.

The remainder of the paper proceeds as follows. In Section 2, we outline the necessary details of the institutional context. Next, we present data sources, key variables, and some descriptive statistics in Section 3. Consequently, we discuss the RDD used in the analysis and our identifying assumptions in Section 4. In Section 5, we present and discuss our results, and we conclude the paper with some final remarks in Section 6.

## 2 Institutional Context

### Tracks in Upper Secondary Education

In Norway, upper secondary education is free and predominantly provided by public schools.[6] Students apply for upper secondary school at age 15 or 16, and they must choose between several different tracks. Table 1 in Section 3 provides the full list of possible study tracks in upper secondary education. Around half of all students attend the General Academic track, which is geared towards preparing students for higher education and is considered more academic in nature. The General Academic track lasts three years and upon completion, students qualify for admission to higher education.[7] The other main options are vocational tracks, which are more practical in nature and focus on preparing students for the workforce. There are several different vocational tracks from which to choose, including Construction, Electrical Engineering, Industrial Technology, and Health

[6] Prior to upper secondary school, it is mandatory for children aged 6 to 16 to attend elementary school (grades 1–7) and lower secondary school (grades 8–10).

[7] Other tracks that last for three years and provide qualification for higher education are Sports, Media & Communication, Music, Dance & Drama, Academic with Arts, and Arts & Crafts.

Services. These tracks typically last for four years, two of which are designated to an apprenticeship. Some of these tracks also qualify students for certain licenses, such as those needed to work in such trades as plumbing and electrical work. Students enrolled in vocational tracks also have the option of pursuing an extra year of upper secondary education to qualify for higher education.

### Admissions Process

The admissions process for upper secondary tracks and schools differs between and has changed within counties over time. In the counties and periods considered in this study, students compete with their lower secondary GPA to gain admission to their preferred upper secondary track and school.[8] Students are asked to rank their preferences for upper secondary education, listing their top three tracks of choice, as well as up to three schools within each track, for a total of up to nine options. All students are guaranteed access to a spot in one of their three preferred tracks. Applications are submitted through an online centralized system, which uses a deferred acceptance assignment scheme to assign students to tracks and schools (Gale and Shapley, 1962). The online system works as a clearing house, allocating students to their preferred choices based on their stated preferences and ranking among other applicants. The ranking is objective and solely based on grades, meaning schools have no input in the selection process, aside from specifying the number of students they are accepting for a track in a particular year.[9]

### School Regions

While the admissions process is decided at the county level, students generally enroll in schools in their own or nearby municipalities. To create measures of the relevant tracks and within-track school options each student, we construct school regions, defined as clusters of municipalities based on between-municipality student traffic. We define the traffic share from municipality $i$ to municipality $j$ as the number of students from municipality $i$ that attend upper secondary school in municipality $j$ divided by the total number of upper secondary students from municipality $i$. We construct the municipality clusters based on a sensitivity level of 10% traffic and a traffic size of at least 10 students to avoid over-sensitive pairings. Pairings were then made using a two-level network loop based on upper secondary school municipalities and incoming traffic, resulting in 39 upper secondary school regions averaging four municipalities each.

[8] In counties where allocation is not based on grades, students are either guaranteed intake or heavily prioritized in the admissions process at the nearest school that offers their desired educational track.

[9] For some tracks, such as Sports and Music, Dance & Drama, admissions are partly audition-based.

# 3 Data and Descriptive Statistics

## Data and Sample Selection

Our analysis is based on data from 172,770 applications to Norwegian upper secondary education in the period 2011 to 2016. These applications, which are recorded and provided through the centralized online application system VIGO, contain information on each student's preferred track-school combination. We enable our RDD by restricting attention to Norwegian counties where admission to upper secondary education is based on the lower secondary GPA, resulting in grade-based cutoffs for oversubscribed track-school combinations.[10] The number of applications per track in our main sample is listed in Table 1. We exclude the tracks that are partly audition-based and the smaller tracks for which we lack power. Our final sample consists of 143,410 applications to the following seven tracks: General Academic, Electrical Engineering, Health Services, Technology & Industry, Media & Communication, Construction, and Service & Logistics.

Using individual-level identifiers, we link application data to several administrative registers covering the entire Norwegian population. Educational registers provide GPAs from lower secondary school, as well as detailed data from upper secondary school: track and school attended in a given year, educational attainment, and grade outcomes, allowing us to track the educational enrollment and performance of both accepted and rejected students. The administrative registers also provide information on a wide range of socio-economic characteristics, such as immigrant background, and parents' education and income levels.

A key variable in the empirical analysis is the year-specific grade-based admission cutoff for oversubscribed track-school combinations. We do not observe this variable directly, but instead use individual-level data to precisely estimate it. Specifically, we follow the threshold estimation theory of Hansen (2000), and the implementation of this theory to our setting in Butikofer *et al.* (2020), to identify the lower secondary GPA cutoff that maximizes the explanatory power of the following regression:

$$E_{ijkqt} = \quad + \quad \mathbb{1}(G_i > G_q) + \tag{1}$$

This equation models $E_{ijkqt}$, the probability of enrollment for student $i$ into school $j$ and track $k$ in year $t$, as a function of whether student $i$ has a higher GPA $G_i$ than student $q$. Through separate iterated regressions at the year-track-school-municipal level, we identify one student $q$ per year-school-track combination that maximizes the regressions' $R^2$ given that the estimated is highly significant and positive. These students' GPAs then serve as the cutoff for each year-specific

[10] These counties are Akershus, Aust-Agder, Hordaland, Møre og Romsdal, Oppland, Oslo, and Rogaland.

track-school combination.

We used the Norwegian Control and Distribution of Health Reimbursement (KUHR) database to construct our main outcome variables of mental health diagnosis. The KUHR database includes individual-level daily records of all GP consultations between 2006 and 2020, and it provides detailed information on each patient's symptoms and diagnoses, as recorded by the GP.[11] Almost all of these symptoms and diagnoses are coded according to the International Classification of Primary Care (ICPC), which is a standardized system for classifying and encoding primary care encounters, so we converted any remaining diagnoses to the ICPC equivalent. In our analysis, we identify all GP consultations related to mental health by using the ICPC codes, and we distinguish between consultations that involved diagnoses of mental health symptoms and those that involved a clinical diagnosis of a mental health disorder.[12] For our outcome variables, we use one indicator called "MH diagnosis", which indicates whether a student is diagnosed with either mental health symptoms or a disorder during the three years following their first application, and one indicator for more severe mental health diagnoses, called "MH disorder", which indicates only whether a student is diagnosed with a mental health disorder within the same period. All diagnoses are measured within the school year of August to July.

## Descriptive Statistics

### Supply Restrictions in Within-Track Options

The share of students being accepted into their preferred track-school combination varies between different tracks, as illustrated in Table 1. The educational consequences of being restricted from one's preferred educational choice depend on track-level supply restrictions. Some tracks are more capacity constrained than others, and rejected students must sometimes attend a non-preferred track. The share of rejected students who enroll in a track different from their preferred one varies from 16.3% for applicants to the General Academic track to 70.0% for applicants to the Sports track, as shown in column four of Table 1.[13]

[11] In Norway, GPs are the main units of non-emergency health treatment and acts as gatekeepers through referrals to specialized care.

[12] In the ICPC classification system, mental health-related diagnoses are designated by codes that begin with the letter "P". We also include the diagnosis code A04, which indicates chronic tiredness, in our definition of mental health diagnosis based on discussions with GPs. Clinical diagnoses of mental health disorders are classified as codes labelled "P70" through "P99".

[13] Appendix Tables B1–B6 detail the tracks attended by non-accepted applicants to the top-six most common tracks (except Sports). Particularly interesting is the combination of Electrical Engineering, Technology& Industry, and Construction. Among applicants to these tracks, those who end up being rejected from their first choice often end up in one of the other tracks within the group. More specifically, there is a tendency toward a hierarchical structure, where rejected Electrical Engineering applicants enroll in one of the other two tracks, whereas Technology&Industry

Table 1: Tracks in Norwegian upper secondary education.

| Track Name | Sample N | Acceptance rate | Track restricted |
|---|---|---|---|
| General Academic | 81,282 | 68.4% | 16.3% |
| Electrical Engineering | 14,435 | 64.9% | 60.2% |
| Health services | 13,839 | 78.2% | 34.4% |
| Sports | 12,207 | 67.2% | 70.0% |
| Technology & Industry | 12,194 | 73.9% | 40.9% |
| Media & communication | 10,089 | 60.8% | 51.2% |
| Music, dance & drama | 6,503 | 65.0% | 69.1% |
| Construction | 6,478 | 85.3% | 48.1% |
| Service & Logistics | 4,709 | 73.8% | 51.0% |
| Design | 3,326 | 80.9% | 47.6% |
| Restauranteering | 2,537 | 88.4% | 55.4% |
| Nature | 2,489 | 81.2% | 41.8% |
| Academic with arts | 2,016 | 73.3% | 62.7% |

Notes: This table presents the different study tracks available in the Norwegian upper secondary education system, as well the number of students in our sample attending each track. The acceptance rate is defined as the percentage of students within each track who enroll in their preferred track-school combination, while being track restricted refers to the share of rejected students who enroll in a non-preferred track.

There are significant regional variations in track-level supply restrictions. Generally, less populated areas have thinner schooling markets and fewer school options within each track. In Section 4, we describe how we use these regional differences in students' within-track options to assess the relative importance of school versus track restriction on students well-being. For the sake of consistency and to center the discussion on the effect of rejection at the students' perspective, we will mostly refer to the degree of track-level supply restrictions as the degree of regional within-track options. We measure this degree as the share of rejected students in a school region who still enroll in their preferred track. Our measure of local track-level supply restrictions are therefore mechanically tied to within-track options for rejected students, and primarily reflects capacity constraints of local study tracks.[14]

rejections only bleed into Construction.

[14]Figure A2 in the Appendix illustrates that the market concentration of schools is much higher in the bottom quartile of regional within-track options. Most track-school combinations in these regions represent either one of two or the only option for students preferring a specific study track.

As expected, the number of within-track school options in a region plays a significant role in determining the educational consequences for students who are restricted from attending their preferred track-school combination. This is illustrated in Figure 1, which demonstrates that regional variations in students' within-track options are correlated with significant differences in the enrollment outcomes of rejected students. In the school regions in the top quartile of students' within-track options, 83% of restricted students pursue their preferred track at a different school. The corresponding percentage in the bottom quartile is only 34%.

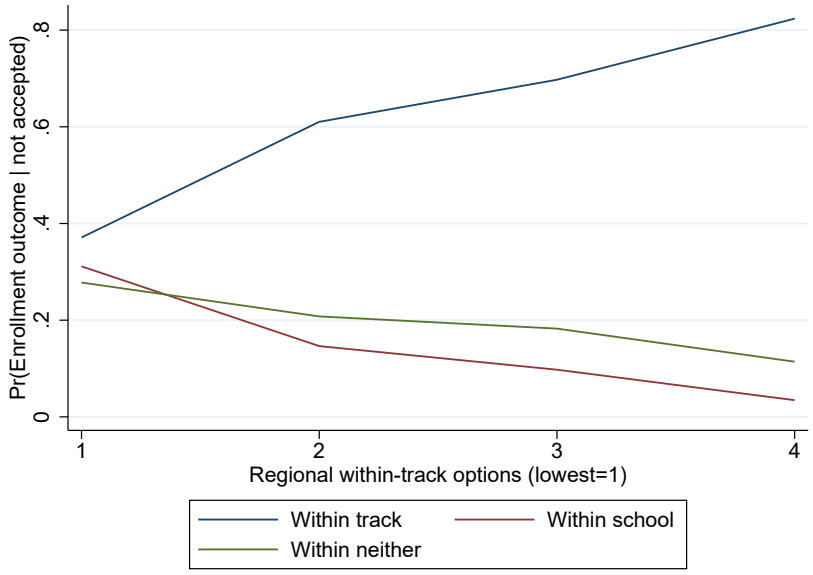


Figure 1: Enrollment outcomes of rejected students by within-track options in their school region

Notes: This figure depicts enrollment outcomes of rejected students by quartiles of school regions ranked by within-track options. The outcomes are enrolling in the preferred track at a different school (blue line), enrolling in a different track at the preferred school (red line), and enrolling in a non-preferred track and school (green line). We define regional within-track options as the share of rejected students in the school region who still enroll in their preferred track at a different school. We then rank all school regions by this measure and split them into equally sized quartiles in terms of number of students.

### Sample Descriptives

Table 2 provides the descriptive characteristics of the full sample, where half of applicants are males, 9 in 10 were born in Norway, and around half have highly educated parents. In terms of mental health treatment and diagnosis, 17.3% of students have been diagnosed with either mental health symptoms or a disorder by their GP, while a subset of 6.0% has been diagnosed with a mental health disorder. The applicants' average GPA from lower secondary school is 4.10 (of a possible 6),

and 69% have been accepted into their preferred track-school combination.[15]

Since our empirical approach compares applicants across track-school combination cut-off points, Table 2 also lists the descriptive statistics of our RDD sample of students who applied to oversubscribed track–school combinations and whose lower secondary GPA values straddle the admission threshold.[16] Compared to the overall population, students in our RDD sample are more likely to be male and are slightly more likely to have parents with a higher education level. Otherwise, they are remarkably similar to the full sample, except that fewer are accepted into their preferred track-school combination.

Table 2: Descriptive statistics for RD sample and full student population in relevant counties

| List of pre-application variables | Full Sample | RDD Sample |
|---|---|---|
| Share of male students | 50.9% | 55.2% |
| Share of Norwegian students | 91.1% | 90.1% |
| Share of students with highly educated parents | 52.5% | 55.7% |
| Share of students with mental health symptoms or disorders | 17.3% | 16.7% |
| Share of students with mental health disorders | 6.0% | 5.7% |
| Lower secondary school GPA | 4.10 | 4.02 |
| Accepted into preferred track and school | 70.2% | 58.4% |
| N | 172770 | 32390 |

**Mental Health of Accepted Versus Rejected Students**

In Figure 2, we explore the relationship between students' mental health, being rejected from one's preferred track-school combination, and the within-track options in the school region. The figure shows the share of students with mental health diagnoses (Panel a) and disorders (Panel b) by quartiles of school regions are ranked by their level of within-track options. Both panels show that restricted students are more likely to be diagnosed with mental health symptoms and disorders during upper secondary school. Furthermore, the gap between accepted and rejected students is greater when the number of within-track options in the school region is low.[17]

[15] In Appendix Figure A1, we show that the lower secondary GPA distributions of accepted and rejected students are more or less comparable across tracks.

[16] We explain our bandwidth choice in Section 4.

[17] In Figure A3 in Section A of the Appendix, we confirm that the mental health gaps we identify within the RDD sample are consistent with what we show for the full sample in Figure 2.

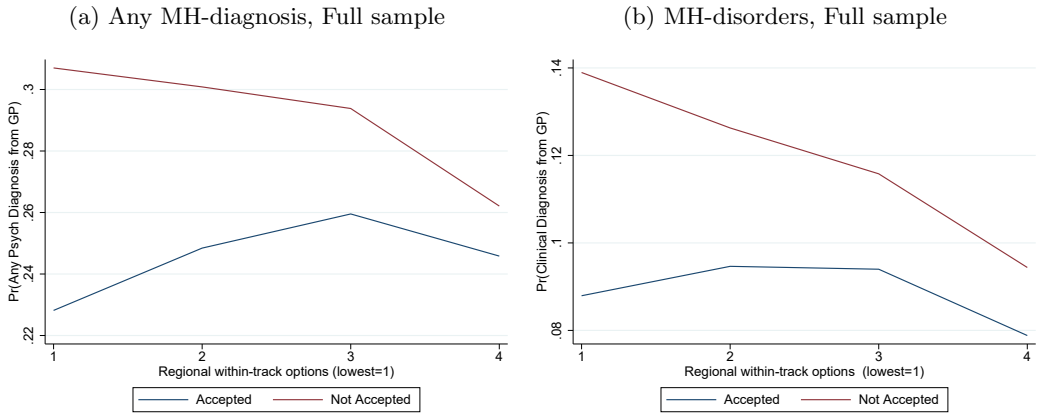


Figure 2: Share of students being diagnosed by their GP with mental health diagnoses (a) or disorders (b) during their first three years of upper secondary school, by the level of within-track outside options in their school region.

# 4 Empirical Framework

To identify the effect of being rejected from enrolling in one's preferred upper secondary education choice, we leverage the fact that acceptance/rejection changes discontinuously at the grade-based admission thresholds of relevant track-school combinations. Specifically, we use the following RDD to compare the outcomes of students above versus below these thresholds:

$$Y_i = a + \ _1 1(G_i > \hat{v}) + \ _2(G_i \quad \hat{v}) + \ _3(G_i \quad \hat{v}) \ \ 1(G_i > \hat{v}) + \ _{jkt} + bX_i + e_i \tag{2}$$

In Equation (2), $Y_i$ is the outcome of interest for individual $i$, and $G_i$ is individual $i$'s lower secondary GPA, our running variable. We normalize this to zero at the threshold by subtracting $\hat{v}$, the (year-specific) admission cutoff of individual $i$'s preferred combination of track and school. $1(G_i > \hat{v})$ is an indicator for whether individual $i$'s lower secondary GPA $G_i$ is above the relevant threshold, and we include the interaction term between $1(G_i > \hat{v})$ and $(G_i \quad \hat{v})$ to allow the slope of the running variable to differ on each side of the thresholds. $_{jkt}$ represents cutoff-fixed effects, meaning that we control for fixed effects for all combinations of schools $j$, tracks $k$, and years $t$, while $X_i$ is a vector of student $i$'s background characteristics, including gender, parental education, and immigrant background. Our coefficient of interest ( $_1$) identifies the causal intention-to-treat effects of being above versus below the relevant grade-based admission threshold. To determine the effect of acceptance (or rejection) on mental health and other outcomes of interest, we adjust the

coefficients by the first-stage effect of being above versus below the threshold on acceptance.[18]

We follow the standard in the RDD literature and use the mean-squared error procedure recommended by Calonico *et al.* (2014) to select common bandwidths on each side of the RDD thresholds. This procedure suggests that the optimal bandwidth is an interval of 0.296 grade points around the cutoff. For transparency and ease of interpretation, we use this bandwidth in all regressions.[19] To weigh observations, we use triangular or linear weighting based on the distance to the cutoff faced by students for their most preferred track–school combination. This means that students closer to the cutoff are given more weight in the model than students at the edge of the RDD sample. Finally, standard errors are clustered at the school region - year level, and students with lower secondary school GPA within 0.01 points of the admission thresholds are excluded to address measurement error issues caused by estimated cutoffs.

### Identifying Assumptions

Our RDD specified in Equation (2), will identify the causal effect of being denied one's preferred upper secondary education choice if the following assumptions hold. The first assumption is that enrollment in the preferred track-school combination changes discontinuously at the specified cutoffs. We provide evidence in Section 5.1 that this assumption holds. The second assumption is that there is random assignment around the cutoffs, meaning that students cannot manipulate their treatment assignment. This is likely true because grade-based cutoffs vary from year to year and cannot be predicted accurately in advance.

To further support the assumption of random assignment around the cutoffs, in Table 3, we provide evidence that there are no systematic differences in the characteristics and pre-treatment outcomes of students above versus below the cutoff points. In Panel A, we show there are no differences in the fixed characteristics of students above versus below the cutoffs. Furthermore, in Panel B, we compare the pre-treatment outcomes of students above versus below the cutoffs, and we find no significant difference in mental health diagnosis in the three years prior to upper secondary school enrollment between students above versus below the cutoff of their preferred track-school combination.

[18] This is similar to a 2SLS approach in which we instrument acceptance/rejection by being above the relevant thresholds. To avoid overloading the reader, we do not report results from the 2SLS approach.

[19] The only exception to this is a heterogeneity analysis looking at specific tracks within the most rural regions, and this is because we needed a broader bandwidth due to loss of power when reducing the sample size.

Table 3: Background characteristics and pre-treatment outcomes are balanced across RDD thresholds

| | | | |
|---|---|---|---|
| **Panel A. Background characteristics** | | | |
| | (1) | (2) | (3) |
| | Male | Born in Norway | High-ed parents |
| Above cutoff | -0.004 | 0.013 | 0.020 |
| | (0.0114) | (0.0090) | (0.0138) |
| *N* | 32347 | 32390 | 32390 |
| **Panel B. Pre-treatment outcomes** | | | |
| | (4) | (5) | (6) |
| | MH diagnosis | MH disorder | # GP consultations |
| Above cutoff | 0.002 | -0.002 | 0.053 |
| | (0.0105) | (0.0060) | (0.1020) |
| *N* | 32347 | 32347 | 32347 |

Notes: This table reports $_1$ coefficients from Equation (2), examining the balance of individual characteristics and pre-upper secondary school outcomes for individuals across the admission thresholds. The outcomes are specified in the relevant header. High-ed parents is defined as having at least one parent with a minimum of two-years worth of university/college studies or a completed degree. The mental health outcomes are cumulative measures for the likelihood of being diagnosed (by the GP) with a mental health diagnosis (column 3) or disorder (column 4), and the total number of GP consultations (column 5) over the three years *prior to* upper secondary school enrollment. We use an optimal bandwidth of 0.296 grade points, based on the procedure described in Calonico *et al.* (2014). Standard errors in parentheses are clustered at the school region - year level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

## Local Treatment Effects and Generalizability

Our RDD identifies the local average treatment effect (LATE) for students around the cutoff grade-based admission thresholds. This means we identify the causal effect of being restricted from a preferred educational path on students on the margin of acceptance based on existing threshold levels. It is important to note that the LATE may not generalize to the overall student population. The LATE could be higher than the average treatment effect (ATE), as the negative impact of rejection may be more severe for students who are close to meeting the threshold. These students may have had higher expectations of being admitted to their preferred choice, leading to a greater sense of disappointment. Understanding whether the LATE equals the ATE is crucial to evaluating

current admission systems and thresholds against alternatives, such as place-based admissions or easing supply restrictions in tracks where demand exceeds supply. The latter alternative would imply that thresholds affect students at a lower point of the lower secondary school GPA distribution, and the welfare effects would depend on the LATE for this group.

### Counterfactual outcomes: Track and school

The estimates from Equation (2) identify, after re-scaling by the first stage, the causal effect of being accepted into one's preferred track and school. As discussed above, the counterfactual of acceptance is enrollment in one's preferred track at a different (non-preferred) school or enrollment in a non-preferred track at the same or a different school. To shed light on the relative importance of track versus school restrictions, we investigate the effects of regional variations in within-track options. To do so, we construct an ordinal ranking of school regions based on the share of rejected students who enroll in their preferred track at another school. This serves as a proxy for what we refer to as the within-track options of a school region. In school regions with a lower availability of within-track options, rejected students are more likely to end up in non-preferred tracks.

## 5 Results and Discussion

Our main finding is that non-admission to a preferred upper secondary educational choices decreases the mental well-being of rejected students. They are more likely to receive a mental health diagnosis by their GP during while enrolled in upper secondary school. Importantly, these effects are driven by rejected students in the school regions with the fewest within-track options, suggesting that track restrictions, rather than school restrictions, are driving the adverse impacts on mental health. Furthermore, we find that rejected students respond to non-admission by re-applying and re-enrolling in their preferred educational choice the year after their initial application. As a result, non-admission to a preferred choice also decreases the likelihood that rejected students finish their upper secondary education on time. Our observed effects do not seem to be driven by peer characteristics at the track-school combination that accepted versus rejected students end up enrolling in.[20]

[20]Further results which we do not discuss in the results section indicate a lack of effect heterogeneity between genders (Appendix Table C3) and a lack of mental health spillovers to the parents of rejected students (Appendix Table C2).

### First Stage

We start by verifying the first stage in our setting. As expected, applicants with a GPA above the relevant grade-based admission cutoff of their preferred track-school combination have a significantly higher likelihood of enrolling in their preferred choice. As shown in columns (1) and (2) in Table 4, the marginal probability of enrollment in one's preferred track-school combination increases by 28.7 percentage points at the admission cutoff, and the estimate is not sensitive to control variables. The clear discontinuity in enrollment probability at the admission cutoff is illustrated in Figure 3. Note that the likelihood of enrollment in the preferred choice is not zero to the left of the admission cutoff due to imprecision in the data-driven estimation of grade thresholds.[21] However, our first stage is very precisely estimated relative to Butikofer *et al.* (2020); this is due to the novel data on students' first-preference applications, as we can accurately pair students to the cutoffs at track-school combinations to which they apply.

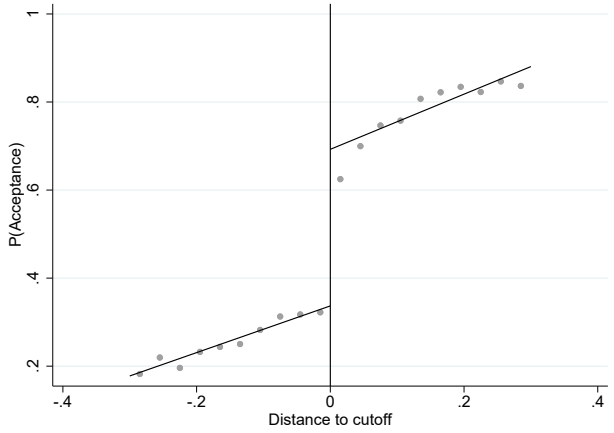


Figure 3: RDD plot for Pr(Enrollment in preferred track-school choice)

### Mental Health Effects

Having established the first stage, we now investigate how students' mental well-being is impacted by being restricted from enrolling in their preferred educational choice. Columns 3 and 4 in Table 4 show that being rejected from a preferred track-school combination increases the likelihood of being diagnosed with a mental health condition. Specifically, as shown in column 3, students who just missed the cutoff for their preferred choice were 2.7 percentage points more likely to be diagnosed

[21] Theoretically, any special intake procedures can also contribute to the same issue, but we have only included applications that go through the normal admissions process. This should alleviate related concerns, and the balance tests from Table 3 are also reassuring in this regard.

Table 4: Main RDD results: Effects of preferred school choice admission on mental health

| | First-stage | | Reduced-form mental health outcomes | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | 1st choice enrollment | 1st choice enrollment | MH diagnosis | MH disorder | #GP consultations |
| Above cutoff | 0.289*** | 0.287*** | -0.027** | -0.013 | -0.317** |
| | (0.0121) | (0.0123) | (0.0123) | (0.0084) | (0.140) |
| | [0.59] | [0.59] | [0.262] | [0.097] | [5.490] |
| Cutoff-fixed effects | yes | yes | yes | yes | yes |
| Controls | no | yes | yes | yes | yes |
| (N) | 32390 | 32347 | 32347 | 32347 | 32347 |

Notes: This table reports $_1$ coefficients from Equation (2) for the outcome specified in the header. The mental health outcomes are cumulative measures for the likelihood of being diagnosed (by the GP) with a mental health symptom or disorder (column 3) or only disorders (column 4), and the total number of GP consultations (column 5) over the three years following upper secondary school enrollment. We use an optimal bandwidth of 0.296 grade points, based on the procedure described in Calonico *et al.* (2014). Standard errors in parentheses are clustered at the school region - year level, which number 228 in total. Sample means in brackets.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

with a mental health symptom or disorder within three years of enrolling in upper secondary school. Resizing this with the first stage, this translates to a 9.4 percentage point difference in outcomes between accepted and rejected students.[22] This corresponds to around 36.8 percent of the sample mean and is statistically significant. When considering only clinical diagnoses of mental health disorders in column 4, the estimated effect is in the same direction, but it is not statistically significant.[23] The RDD plots corresponding to columns 3 and 4 in Table 4 can be found in Appendix Figure A4, panels (a) and (c).[24]

In addition, we find that students who just missed the cutoff for their preferred track-school combination had significantly more GP consultations during their first three years after applying to upper secondary school. As shown in column 3, the reduced form estimate is 0.3, meaning that

[22] $0.027/0.287 \approx 0.094$.

[23] The p-value of the estimated effect is 0.116.

[24] Our finding of a negative effect of rejection on mental health during upper secondary school seemingly contradicts the findings in Butikofer *et al.* (2020). However, as we show below, this discrepancy is due to our different sample. Specifically, when examine the subsample of school regions studied in Butikofer *et al.* (2020)., we also found no effect.

the effect of being restricted from one's preferred choice translates to about 1.1 more GP visits.

Table 5 delves deeper into the mental health effects by examining outcomes measuring the interaction between receiving a mental health diagnosis in upper secondary school and having received a mental health diagnosis in lower secondary school. The table illustrates that being above the cutoff only affects the combined outcome of not receiving a mental health diagnosis in lower secondary school but receiving one in upper secondary school. This implies that the mental health effects we identify primarily concern students who did not have a prior mental health diagnosis.

Table 5: Mental health effects driven by students without prior MH diagnosis

| | (1) MH diagnosis in upper secondary but not in lower secondary | (2) MH diagnosis in upper secondary and in lower secondary |
|---|---|---|
| Above cutoff | -0.028*** | 0.000 |
| | (0.0111) | (0.0079) |
| Cutoff-fixed effects | yes | yes |
| Controls | yes | yes |
| *N* | 32347 | 32347 |

Notes: This table reports $_1$ coefficients from Equation (2) for the outcomes Y = MH diagnosis (by the GP) in upper secondary school and in lower secondary school(column 1), and Y = MH diagnosis in upper secondary school but not in lower secondary school (column 2). The outcomes are cumulative measures. We use an optimal bandwidth of 0.296 grade points, based on the procedure described in Calonico *et al.* (2014). Standard errors in parentheses are clustered at the school region - year level, which number 228 in total.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

### School Versus Track Restrictions: The Role of Within-Track Options

In this subsection, we explore the role of school versus track restrictions in explaining the negative mental health impact of upper secondary schooling restrictions. To enable this analysis, we leverage the fact that the educational consequences of being restricted from attending one's preferred track-school combination depends on the within-track options in the school region. The fewer schools in the region offering the preferred track, the greater the likelihood that the restricted student must pursue a non-preferred upper secondary track. If being restricted from enrolling in the preferred track is relatively more important than being restricted from enrolling in the preferred school, the estimated effects on mental health should be greater in school regions with a lower degree of within-

track outside options[25]. Furthermore, as shown in Figure 1, rejected students in school regions with lower levels of within-track options are more likely to attend the same school on a different track than rejected students in other areas. The tracks most likely driving this same-school incidence are the vocational tracks that often are offered at the same schools. The fact that the outside option for many students in school regions with fewer within-track options is to enroll in the same school on a different track should suppress the school effect on students in these school regions, while the same is untrue for the track effect.

Table 6 presents the results of our analysis, which are divided into two panels. Panel A indicates that the first stage of the analysis is consistent across all quartiles of school regions ranked by within-track outside options.[26] Panel B illustrates the mental health impact of being rejected from a preferred track-school choice by the degree of within-track options available to the rejected student. We find that the negative mental health effects of being rejected are driven by students in regions with a lower degree of within-track options (those in the bottom quartile). Students in the bottom quartile experience a statistically significant negative impact on their mental health in terms of the overall likelihood of receiving a mental health diagnosis. Although we cannot find clear evidence of an effect leading to a more severe case of a clinically diagnosed mental health disorder, the point estimate is negative and of a noticeably higher magnitude than similar estimates for the other sub-samples.[27] In contrast, students in regions with a higher degree of within-track outside options (quartiles 2–4) do not experience a significant negative impact on their mental health because of being restricted from their preferred educational choice.[28] These findings are in line with the findings of Butikofer *et al.* (2020), who studied school regions within quartiles 3 and 4. Overall, our analysis implies that the negative mental health impact of being restricted from pursuing one's educational choices is essentially a problem stemming from supply restrictions in the education markets of low-populated areas. In more populous areas, where there are more options available, non-accepted students are more likely to get admission to a school of comparable quality

[25] As explained in Section 4.1, we rank school regions based on the degree of within-track options – more specifically, the share of rejected students who still enroll in their preferred track (at another school).

[26] We pool the top two quartiles due to the fact that there are fewer regions in these quartiles (quartiles are based on the number of students, and there are more students in regions with more within-track outside options). The pooling is necessary to ensure a sufficient amount of clusters for the standard errors.

[27] We also provide further evidence of the validity of the results for students in regions with a lower degree of within-track options. Appendix Figure A4 shows the RDD plot. Appendix Table C1 shows that pre-treatment mental health outcomes are balanced across the thresholds for these students. Finally, the effects on mental health diagnoses in this subgroup are statistically significant when performing a Wald test with 999 bootstrap replications (t-statistic of -2.6754).

[28] Note that the smaller sample sizes for the subsample analysis in Table 6 result in less precise point estimates. Most coefficients are not significantly different from the main effects concerning the overall sample, which are presented in Table 4.

Table 6: Effects by within-track options in the school regions

| | School region, by within-track options | | |
|---|---|---|---|
| | Q1 (Least options) | Q2 (2nd-least options) | Q3 & Q4 (Most options) |
| | (1) | (2) | (3) |
| **Panel A. First stage** | | | |
| 1st choice enrollment | 0.269*** | 0.287*** | 0.288*** |
| | (0.0288) | (0.0198) | (0.0202) |
| MH diagnosis | -0.055** | -0.026 | -0.013 |
| | (0.0263) | (0.0314) | (0.0147) |
| | [0.254] | [0.270] | [0.258] |
| MH disorder | -0.035 | 0.010 | -0.012 |
| | (0.0215) | (0.0204) | (0.0104) |
| | [0.099] | [0.108] | [0.089] |
| Cutoff-fixed effects | yes | yes | yes |
| Controls | yes | yes | yes |
| School-region#year clusters | 127 | 66 | 33 |
| N | 6363 | 7879 | 17728 |

Notes: This table reports $_1$ coefficients from Equation (2), measuring the effect of being above versus below the relevant track-and-school admissions thresholds on the outcomes specified in the left-most column. The reported coefficients are for different subsamples of school regions ranked by the degree of within-track options, as specified in the column headers. The (ordinal) ranking of school regions are based on the share of rejected student who enroll in their preferred track at another school. "MH diagnosis" and "MH disorder" are cumulative measures for the likelihood of being diagnosed (by the GP) with a mental health *symptom or disorder* (MH diagnosis) or mental health disorder (MH disorder) over the three years following upper secondary school enrollment. We use an optimal bandwidth of 0.297 grade points, based on the procedure described in Calonico *et al.* (2014). Standard errors in parentheses are clustered at the school region - year level. Sample means in brackets.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

within the same track as their first preference.

Table 7: Mental health effects by applied track within bottom quartile.

| | Vocational | General Academic |
|---|---|---|
| MH diagnosis | -0.0736** | -0.0369 |
| | (0.0362) | (0.0334) |
| First-stage (Admission) | 0.490*** | 0.188*** |
| | (0.0469) | (0.0360) |
| Cutoff-fixed effects | yes | yes |
| Controls | yes | yes |
| Bandwidth | 0.476 | 0.447 |
| School-region#year clusters | 110 | 123 |
| *N* | 3059 | 5426 |

Notes: This table reports $_1$ coefficients from Equation (2), measuring the effect of being above versus below the relevant track-school admissions thresholds on the outcomes specified in the left-most column. Column 1 concerns students applying for the vocational tracks of Electrical Engineering, Technology Production or Construction within the sample quartile in which students have the fewest outside options. Analogously, column 2 concerns General Academic track students. Bandwidths are chosen through rdbwselect (Calonico *et al.*, 2014) for each group to maximimize the power of the two-stage RDD-model. Standard errors in parentheses are clustered at the school region - year level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To further understand the impact of track versus school restrictions, we conduct a heterogeneity analysis by examining the effects separately for students applying to vocational or academic tracks in the school regions with the fewest within-track options. The results of this analysis are presented in Table 7 and demonstrate that non-admission to vocational tracks significantly affects students' likelihood of mental health diagnosis, while non-admission to the General Academic track does not.[29] In column 1, we show the effects on mental health diagnosis for students who applied to either Electrical Engineering, Technology & Industrial Production, or Construction, three tracks in which between-track traffic is especially common.[30] Because schools that offer one of these vocational tracks often offer several of them, these tracks are primary drivers of the incidence of

[29] Corresponding RDD plots are available upon request.
[30] See Tables B2, B4, and B6 in the Appendix Section B.

students ending up in the same school but on a different track from their first choice.[31] In column 2 of Table 7, we show the (lack of) effects on mental health diagnosis for applicants to the General Academic track.

Our analysis suggests that easing local supply restrictions within popular vocational tracks could lead to substantial improvements in student outcomes. While local labor markets may become over-saturated with certain vocations, this is unlikely to be the case on a national level. Since the areas in with the fewest within-track options are less densely populated, the cost adjusting intake quotas should be manageable, especially considering the alternative costs in terms of health service usage. Overall, our analysis indicate that the negative impact on mental health resulting from non-admission to a preferred track is stronger than the negative impact resulting from non-admission to a preferred school.

### Peer Characteristics

Other potential factors contributing to the mental health effects we see in students who are rejected from their preferred track and school choice are social dimensions and peer effects. This is especially relevant in our setting, as Butikofer *et al.* (2020) found that being accepted versus rejected changed peer and teacher characteristics among students in the school regions of Oslo and Bergen. In Table 8, we investigate the effect of being above versus below the relevant admission threshold on the peer characteristics of students enrolled in the same track-school combination. The first two rows show that students who are accepted into their preferred track-school choice have more peers from their lower secondary school, indicating a preference for attending the same school and track as friends. This implies that rejection from a preferred educational choice can lead to a decrease in the number and share of established social connections among upper secondary school peers, which can in itself negatively impact mental well-being.

The results suggest that the negative impact of rejection from a preferred choice on the number and share of peers from lower secondary school is stronger in school regions with lower levels of within-track options.[32] However, the data also shows that the average rejected student in these school regions still enrolled with 20 students from the same lower secondary school. Therefore, it does not seem the case that rejected students in these regions on average end up in schools with few peers they know. In addition, as shown in Figure 1, about a third of rejected students in the

[31] Within the bottom quartile regions, 48% of rejected applicants to one of these three vocational tracks end up in the same school, but in a non-preferred track.

[32] These results are partially mechanical in the sense that students in less populated areas (who have lower levels of within-track options) have fewer upper secondary track and school options. In addition, these areas typically have fewer lower secondary schools compared to more populated areas.

most within-track-restricted regions end up in the same school, but on a different track from that to which they applied as their first choice. This suggests that while going to the same school as peers from lower secondary school could be important for students' mental well-being, the fact that a large portion of non-accepted students ends up in the same school should mitigate such school-specific effects. Therefore, the strong effects in the most within-track-restricted regions lend support to the notion that track restriction is important for students' well-being, as the likelihood of ending up in another track after rejection is much higher in these regions.

In Table 8, we also present the effects of acceptance/rejection on the share of upper secondary school peers with a prior history of mental health symptoms or disorders. If we can find significant differences across the RDD thresholds, it would suggest that the negative mental health effects on rejected students could be partly caused by peer effects within mental health. However, we find little evidence of changes to peers' mental health across the RDD thresholds. The only weakly significant effect we observe is on the share of peers with a prior mental health disorder among students in school regions with above-median levels of within-track options. Overall, there is no indication that the mental health effects we observe are influenced by any differences in the mental health characteristics of peers across the RDD thresholds.

### Student Responses: Reapplications, Enrollment and Completion

Having established the negative effect of being restricted from a preferred educational choice on mental well-being, we investigate students' responses to rejection in Table 9. We first examine re-application behavior in the first and second rows. The first row shows that rejected students are about 3.3 percentage points more likely to re-apply to their preferred track-school combination in the year following rejection.[33] This fully explains the sample share of rejected students who re-apply to their initial preferred track-school combination in the following year (2.9%). The second row of Table 9 further demonstrates that being restricted from a preferred educational choice also increases re-applications to *any* available track-school combination. Columns (2) and (3) clearly show that the effects on re-applications are driven by rejected students in the school regions with the lowest degree of within-track options. This again highlights the relative importance of track (versus school) restrictions in driving adverse effects on students' mental well-being.

The third row of Table 9 documents that the re-application resulting from rejection also increases the likelihood of enrolling in the first year of the preferred track in the following year. While school completion rates are unaffected in the full-sample analysis, there is evidence of effects on completion among students in regions with the fewest within-track options. In these regions, rejected students

[33] Reduced form estimate -0.009 divided by a first stage of 0.269.

Table 8: Effects on peer characteristics

| | | School region, by within-track options | |
|---|---|---|---|
| | | Q1 | Q3 & Q4 |
| | Full sample | (Least options) | (Most options) |
| | (1) | (2) | (3) |
| # former schoolmates | 2.505*** | 5.656*** | 1.100** |
| | (0.563) | (1.457) | (0.495) |
| | [19.3] | [28.0] | [14.8] |
| Share former schoolmates | 0.028*** | 0.060*** | 0.013** |
| | (0.0056) | (0.0148) | (0.0055) |
| | [0.252] | [0.447] | [0.164] |
| Share classmates with MH diagnosis | -0.001 | 0.002 | -0.002 |
| | (0.0018) | (0.0053) | (0.0023) |
| | [0.158] | [0.144] | [0.159] |
| Share classmates with MH disorder | -0.002 | 0.001 | -0.003* |
| | (0.0013) | (0.0030) | (0.0017) |
| | [0.050] | [0.054] | [0.045] |
| Cutoff-fixed effects | yes | yes | yes |
| Controls | yes | yes | yes |
| School-region#year clusters | 228 | 127 | 33 |
| N | 32347 | 6363 | 17728 |

Notes: This table reports $_1$ coefficients from Equation (2), measuring the effect of being above versus below the relevant track-and-school admissions thresholds on the outcomes specified in the left-most column. The reported coefficients are for the full sample (column 1) and different subsamples of school regions ranked by the degree of within-track options, as specified in the headers of column 2 and 3. The (ordinal) ranking of school regions are based on the share of rejected student who enroll in their preferred track at another school. We use an optimal bandwidth of 0.297 grade points, based on the procedure described in Calonico *et al.* (2014). Standard errors in parentheses are clustered at the school region - year level. Sample means in brackets.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Effects on subsequent application and enrollment behavior

| | | School region, by within-track options | |
|---|---|---|---|
| | | Q1 | Q3 & Q4 |
| | Full sample | (Least options) | (Most options) |
| | (1) | (2) | (3) |
| Exact repeat application | -0.009** | -0.044*** | 0.003 |
| | (0.0041) | (0.0134) | (0.0032) |
| | [0.016] | [0.022] | [0.011] |
| Application to any first-year program | -0.015** | -0.064*** | 0.004 |
| | (0.0068) | (0.0210) | (0.0052) |
| | [0.044] | [0.063] | [0.032] |
| Enrollment after initial track rejection | -0.006** | -0.027*** | 0.001 |
| | (0.0030) | (0.0092) | (0.0026) |
| | [0.008] | [0.013] | [0.005] |
| On-time completion | 0.012 | 0.070* | -0.010 |
| | (0.0141) | (0.0370) | (0.0178) |
| | [0.663] | [0.581] | [0.714] |
| Completion within one extra year | 0.001 | 0.093** | -0.027 |
| | (0.0146) | (0.0422) | (0.0170) |
| | [0.772] | [0.721] | [0.805] |
| Cutoff-fixed effects | yes | yes | yes |
| Controls | yes | yes | yes |
| School-region#year clusters | 228 | 127 | 33 |
| N | 32347 | 6363 | 17728 |

Notes: This table reports $_1$ coefficients from Equation (2), measuring the effect of being above versus below the relevant track-and-school admissions thresholds on the outcomes specified in the left-most column. The reported coefficients are for the full sample (column 1) and different subsamples of school regions ranked by the degree of within-track options, as specified in the headers of column 2 and 3. The (ordinal) ranking of school regions are based on the share of rejected student who enroll in their preferred track at another school. We use an optimal bandwidth of 0.297 grade points, based on the procedure described in Calonico *et al.* (2014). Standard errors in parentheses are clustered at the school region - year level. Sample means in brackets.



* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

are less likely to graduate within 4 or 5 years.[34] The persistent effect on school completion suggests rejection increases dropouts, as well as delays to school progression.

The relationships between rejection and re-application, re-enrollment and completion further indicate the importance of rejected students' outside options. In regions with more within-track options, students can easily transfer schools while maintaining their preferred track and thus enter higher grades directly, without potentially having to repeat first grade. In contrast, in regions with fewer within-track options, students with strong preferences risk losing progress toward completion of their upper secondary education if they are unsatisfied with their current study track. Such delays are inefficient in terms of resource allocation and can be avoided through a better system design.

# 6 Conclusion

In many education systems, there is fierce competition for scarce slots in tracks or schools (Hsieh and Urquiola (2006); Hastings and Weinstein (2007)) Our findings provide new insights into the adverse effects of educational supply restrictions in such settings. In the Norwegian setting, in which students must rank tracks and schools by preference in their application to upper secondary education, many students are restricted from pursuing their preferred educational choice. In the regions and periods under study, acceptance versus rejection is decided based on meritocratic grade-based admission policies. Using an RDD with these thresholds, we find that rejected students are 9.4 percentage points more likely to be diagnosed with a mental health related symptom or disorder in the three years following enrollment in upper secondary school. Moreover, we find that this adverse impact is entirely driven by track-level supply restrictions: effects are only present among students in school regions in which there are few to no within-track outside options for rejected students. We find that rejected students who are subject to a stronger degree of track-level supply restrictions respond by later re-applying and re-enrolling in the first grade of their preferred track, further affecting on-time completion rates.

The mechanism of supply restrictions causing negative effects for affected students is likely to be relevant in other countries and settings, regardless of differences in their educational systems. Furthermore, whereas any potential adverse effects of supply restrictions could be attributed to regional lack of public funding in some countries, our results from Norway suggests that low population density may be a more general factor. If so, these negative effects on students losing out on their preferred educational choices in merit-based admission policies may be even more severe

[34] School completion is measured relative to the expected time frame for the attended study track. Some tracks have an expected time frame of three years, whereas some are expected to last four.

in countries with less public resources compared to Norway.

Our results help inform the debate on admission policies in secondary education. While it is unclear if non-merit-based admission policies (e.g. place based) would improve allocation and students' overall well-being, our analysis suggests that easing supply restrictions to oversubscribed tracks could help improve students' well-being.[35] This could be achieved by increasing the number of within-track school options in a school region. However, policymakers must weigh the potential benefits and drawbacks of increased competition between schools in an area, as previous studies have yielded mixed results (Hoxby (1994); Hoxby (2000); Belfield and Levin (2002); Hsieh and Urquiola (2006); Abdulkadiroğlu *et al.* (2014)). At the very least, policymakers must consider which types of educational programs are capacity constrained and where students' outside options are particularly limited. Our study highlights the importance of understanding the enrollment outcomes of students who do not gain access to their education of choice, and of considering the diverse effects of rejection rather than solely focusing on the effect of acceptance into a preferred choice of upper secondary education.

To speculate, the adverse impact of non-admission to a preferred choice may be exacerbated by a lack of clear expectations and information among students. To address this, the Norwegian system could delay upper secondary school application deadlines until after final exams, which would reduce students' uncertainty about enrollment outcomes and allow them to make more strategic choices in their applications. Additionally, policies could be implemented to make the application and admissions processes more transparent for students. For example, providing live information about which study programs are oversubscribed before the final application deadline could help students set more realistic expectations about likely enrollment outcomes, and adjust their strategy accordingly based on both their post-exam GPA and the capacity constraints of local study programs.

Our analysis opens up multiple possibilities for further research. In addition to the effects on students' well-being while in upper secondary school, policymakers should also consider the long-term effects on students' labor market outcomes. However, our data period does not allow us to track the future labor market earnings of the students in our sample. Another avenue of future research would be to conduct a more in-depth analysis of how outcomes differ in regions with grade-based competition and regions with alternative admission systems. This could provide insights into the effectiveness of different student allocation regimes and could be especially relevant in areas with few schools and limited options for specific study tracks. It is likely that no single regime will be ideal for all students.

[35] In Norway, our analysis suggests that the vocational tracks of Electrical Engineering, Technology and Industrial Production, and Construction may deserve particular attention from policymakers.

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# Appendices

## A Figures

In Figure A1, we show the GPA distribution for the different study tracks. Notably, STUSP1 is the General Academic track, ELELE1 is Electric Engineering, MKMED1 is Media & Communications and TPTIP1 is Technology & Industrial Production. Other than this, HSHSF1 is Health Services, SSSSA1 is Service & Logistics and BABAT1 is Construction. The other tracks are either excluded from our main analysis due to alternative intake requirements (IDRET1/Sports and MDMDD1/Music, Dance & Drama) or due to an insufficient amount of students.

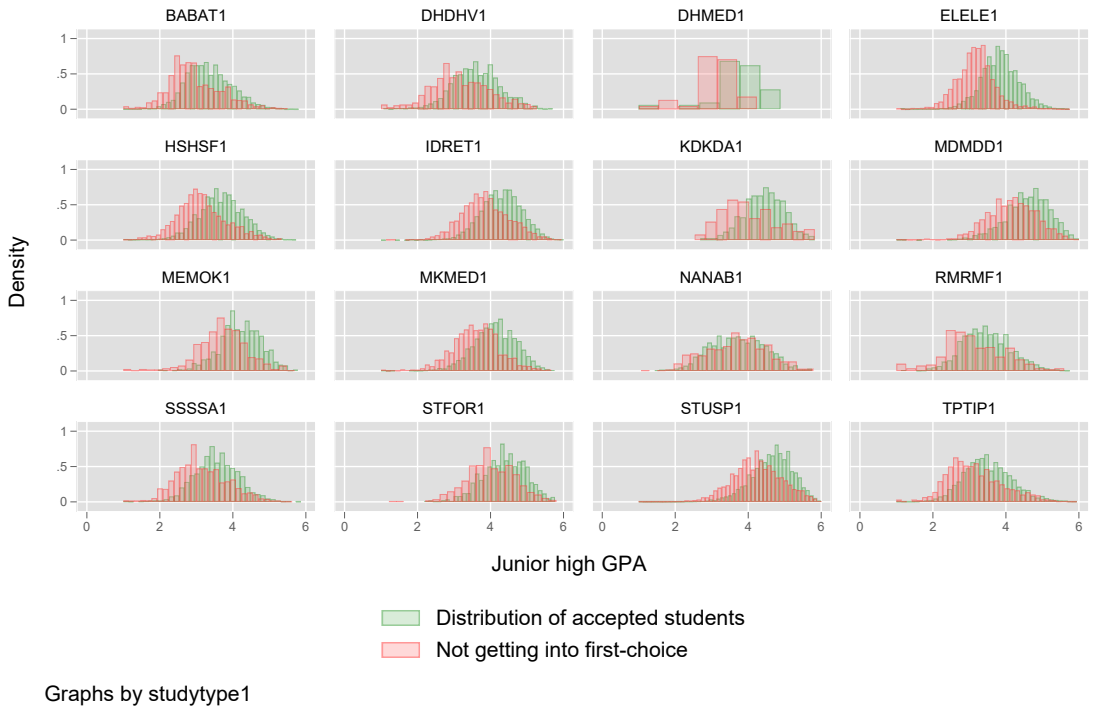



Figure A1: Prior GPA distribution of accepted and rejected students, split by track

Figure A2 shows the density of within-track education provision in the school regions belonging to each quartile. Notably, the total number of schools in quartiles 1 and 2 is slightly greater than that in the upper quartiles. This is due to the distribution of within-track options being divided by quartiles of approximately equal size in terms of students. The bottom quartile therefore consists of many areas with low population density, which means many schools with fewer students per school. In school regions in which students have an above-median number of within-track options,

the average number of schools to choose from within a track is 10.5. In school regions belonging to the bottom quartile, the corresponding number is only 2.4. As shown in the figure, the modal number of within-track school options is 1 in the school regions in the bottom quartile of students' outside options, meaning that schools being the only provider of a study track is common.

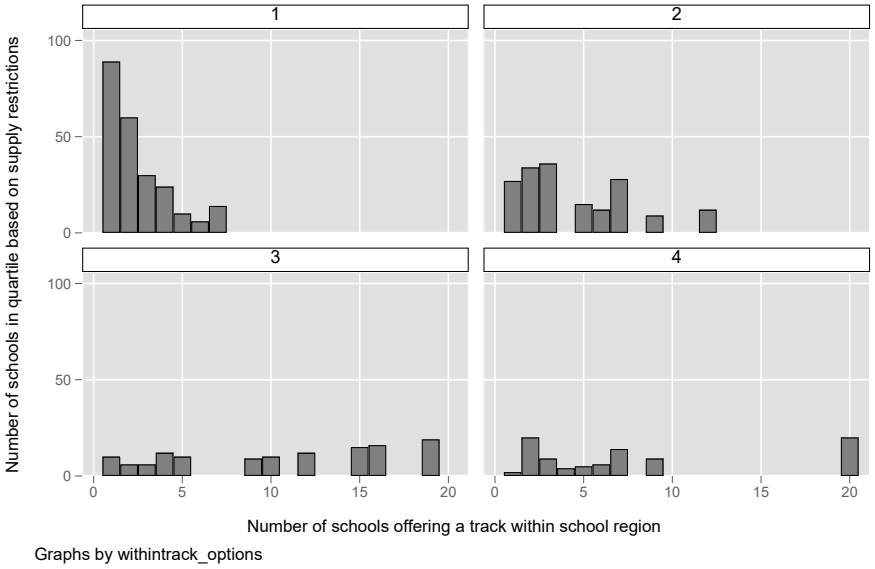
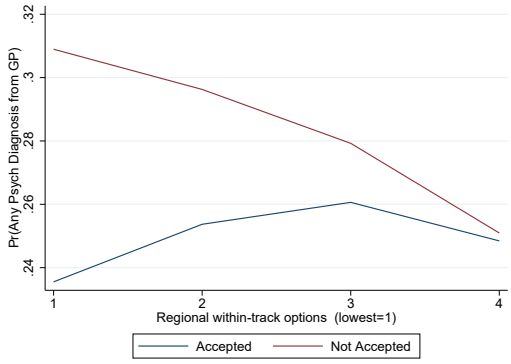



Figure A2: Market concentration: Distribution of within-track options in the various quartiles.

*Notes: This gure shows discrete frequency-based histograms of the number of within-track options (number of schools o ering a given track) in school regions. The number above each gure indicates the quartiles of track-level supply restrictions, each of which can contain several school regions. Observations are de ned at the school-track-region level, meaning that they represent all unique school-track combinations in the various school regions. The x-axis indicates the number of schools o ering a track within a school region. The y-axis counts the total number of schools that are in competition with (x 1) other local schools in the provision of a study track within the quartile. The gure is based on the same upper secondary tracks we use in the analysis, excluding Sports and Music, dance & drama, which are partly performance based, and smaller tracks due to lack of power.*

(a) MH-diagnosis, RDD sample




(b) MH-disorders, RDD sample

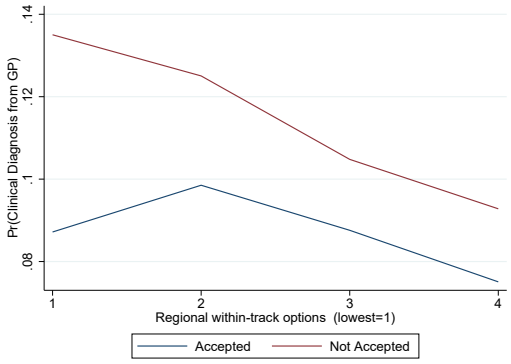
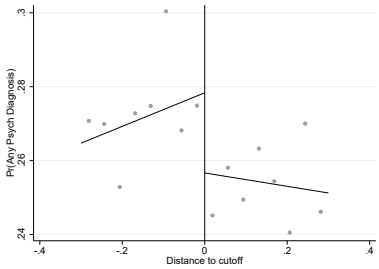
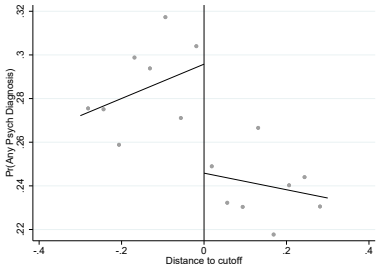



Figure A3: Share of students being diagnosed by their GP with mental health diagnoses (a), which include symptoms, or disorders (b) during their first three years of upper secondary school, by the level of within-track outside options in their school region. The figure is analogous to Figure 2, but only includes students in the RDD sample.

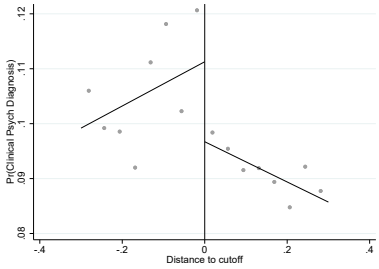
(a) MH diagnosis, Full sample



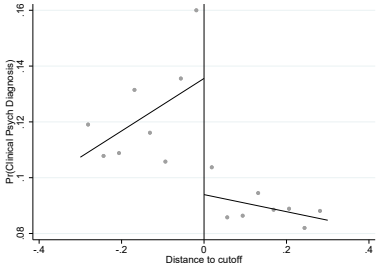

(b) as (a), Bottom quartile



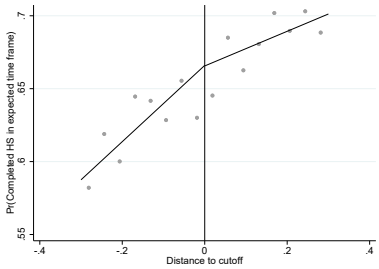

(c) MH disorder, Full sample



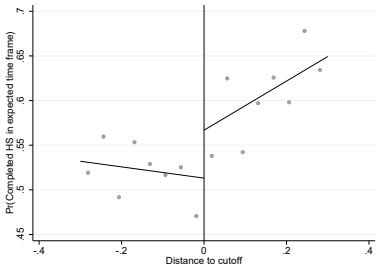

(d) as (c), Bottom quartile



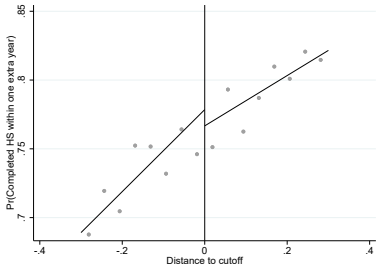

(e) On-time completion, Full sample




(f) as (e), Bottom quartile




(g) One-year delay, Full sample




(h) as (g), Bottom quartile

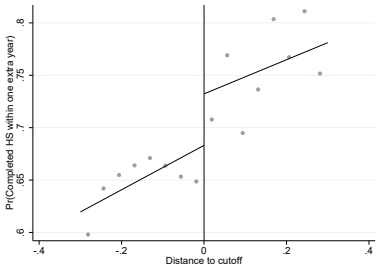



Figure A4: RDD plots of reduced form effects of (non)admission on mental health outcomes (a)–(d) and school completion outcomes (e)-(h). Figures on the left are full-sample estimates, whereas the right-hand-side figures are for students in regions that have the least amount of within-track options.

# B Descriptive Tables

Figures B1-B6 show track enrollment distributions for students who applied to the six most popular study tracks. Especially noteworthy are Tables B2, B4 and B6; they show that track-restricted applicants to Electrical Engineering, Technology & Industrial Production, and Construction often end up in one of the other two tracks.

Table B1: Enrollment distribution over four main tracks (N/A means none) for students who apply to the General Academic track as their highest preference

| First-year track | N | % |
|---|---|---|
| General Academic | 77,887 | 94.33 |
| Sports | 862 | 1.04 |
| N/A | 807 | 0.98 |
| Media & communication | 652 | 0.79 |

Table B2: Enrollment distribution over four main tracks (N/A means none) for students who apply to the Electrical Engineering track as their highest preference

| First-year track | N | % |
|---|---|---|
| Electrical Engineering | 11,570 | 77.81 |
| Tech & Industry | 1,304 | 8.77 |
| Construction | 735 | 4.94 |
| Academic | 424 | 2.85 |

Table B3: Enrollment distribution over four main tracks (N/A means none) for students who apply to Health Services as their most preferred track.

| First-year track | N | % |
|---|---|---|
| Health services | 12,814 | 91.07 |
| Academic | 298 | 2.12 |
| N/A | 245 | 1.74 |
| Design | 171 | 1.22 |

Table B4: Enrollment distribution over four main tracks (N/A means none) for applicants to the Technological and Industrial Production track.

| First-year track | N | % |
|---|---|---|
| Tech & Industry | 11,085 | 88.19 |
| Construction | 531 | 4.22 |
| Academic | 242 | 1.93 |
| N/A | 213 | 1.69 |

Table B5: Enrollment distribution over four main tracks (N/A means none) for students who apply to Media and Communication as their most preferred track.

| First-year track | N | % |
|---|---|---|
| Media & Communication | 8,263 | 81.9% |
| Academic | 698 | 6.9% |
| Service | 177 | 1.7 |
| Health services | 176 | 1.7 |

Table B6: Enrollment distribution over four main tracks (N/A means none) for applicants to the Construction track.

| First-year track | N | % |
|---|---|---|
| Construction | 6,147 | 92.19 |
| Tech & Industry | 151 | 2.26 |
| N/A | 127 | 1.90 |
| Academic | 84 | 1.26 |

# C Regression Tables

Table C1: Reduced-form RD placebo psychological outcomes (3 years prior) for students in regions in the bottom quartile of within-track options.

| | (1) | (2) | (3) |
|---|---|---|---|
| | Pr(Any MH-diagnosis) | Pr(MH disorder) | #GP consultations |
| Above cutoff | 0.0169 | -0.006 | -0.0474 |
| | (0.0237) | (0.0157) | (0.253) |
| *N* | 6363 | 6363 | 6363 |

Standard errors in parentheses and clustered at the municipal cluster - year level

* $p < 0{:}10$, ** $p < 0{:}05$, *** $p < 0{:}01$

Table C1 shows that the placebo tests in Table 6 also hold for subsample consisting of students in the regions in the bottom quartile of within-track options.

Table C2: Reduced-form RD for different psychological outcomes for the student's parents, cumulative in the three years following the student's application

| | Father's Psych Outcomes | | Mother's Psych Outcomes | |
|---|---|---|---|---|
| | Pr(Any MH-diagnosis) | Pr(MH disorder) | Pr(Any MH-diagnosis) | Pr(MH disorder) |
| Above cutoff | -0.005 | 0.007 | 0.006 | 0.002 |
| | (0.0119) | (0.0088) | (0.0137) | (0.0105) |
| RD sample averages | 0.222 | 0.097 | 0.382 | 0.162 |
| *N* | 32347 | 32347 | 32347 | 32347 |

Standard errors in parentheses and clustered at the municipal cluster - year level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C2 shows that there are no indications of any spillover effects to parents in the three years following a student's application to upper secondary school. One could imagine network effects within-family when a student receives a health shock, but there is no evidence of such a thing happening. This could also potentially alleviate additional concerns about selection bias as one could imagine a genetic link being more likely to show up if selection is driving the main results (if the students getting diagnosed have a history of mental health diagnosis in the family).

Table C3: Reduced-form RD for mental health outcomes of male and female students, measured cumulatively in the three years following the student's application

| | Male Students | | Female Students | |
|---|---|---|---|---|
| | Pr(Any MH-diagnosis) | Pr(MH disorder) | Pr(Any MH-diagnosis) | Pr(MH disorder) |
| Above Cutoff | -0.0171 | -0.00826 | -0.0334 | -0.00917 |
| | (0.0164) | (0.0109) | (0.0212) | (0.0137) |
| RD sample averages | 0.197 | 0.075 | 0.337 | 0.121 |
| *N* | 17691 | 17691 | 14294 | 14294 |

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C3 shows no significant effects on mental health given a sample decomposed by gender. Due to the admissions process not taking gender into account, the sample split does not represent real world groupings in applications and we do not necessarily estimate causal effects.