Credentialism, Brain Drain, and the Supply of Doctors at the Margin of Medical School Admissions

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August 2026

Abstract

This paper examines the effects of admission to medical school on academic progression, studying abroad, and eventual labor market activities. Using administrative data and an admissions-based empirical design, we show that most students at the margin of medical school admission will "defect" from the centralized university admission system, refusing to pursue an alternative program of study. Instead, some engage in "credentialism" by improving their admission scores and re-applying in a later admission cycle. Others are sources of "brain drain," choosing to study medicine abroad and not return even a decade later. Medical school admission affects the domestic supply of doctors through when students graduate and where they work–not so much through who studies medicine.

Keywords: medical education; education abroad; brain drain; migration; higher education; labor market outcomes

JEL codes: I23, F22, J24

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1 Introduction

Across many OECD countries, health systems face persistent difficulties recruiting physicians to primary care and to rural or otherwise underserved areas [OECD, 2025a]. A common policy response is to expand domestic medical school capacity, which is a bottleneck in the supply of physicians because the number of qualified applicants far exceeds the number of available study places [OECD, 2025b]. Understanding the effects of expanding medical education is therefore an important policy question.

The consequences of expanding medical school capacity are not straightforward. Applicants who are denied admission may postpone their studies and reapply, pursue another field of education, or enroll in medical schools abroad. Additional domestic study places may increase the number of physicians, reduce delays in entering practice, substitute for foreign medical education, and alter the selection of applicants who ultimately become physicians. Expanding capacity may thus affect both the size and the composition of the future physician workforce.

Choosing to study medicine abroad is an especially important adjustment margin in several high-income countries. In 2021, foreign-trained physicians accounted for 19 percent of doctors across OECD countries and more than 30 percent in Norway, Sweden, Canada, the United States, and the United Kingdom [OECD, 2023]. In several of these countries, a substantial share of foreign-trained physicians are domestic citizens who completed their medical education abroad before returning home to practice. Domestic medical school capacity may therefore influence not only how many physicians are trained, but also where they obtain their medical education.

This paper estimates the causal effects of admission to domestic medical school. To do so, we combine comprehensive administrative data on applications, enrollment, and later-life outcomes. Norway has approximately 32,000 practicing physicians, 44 percent of whom obtained their medical degrees outside the country, the majority of whom are Norwegian-born. The data allow us to follow applicants from medical school admission through education and into the labor market, making it possible to examine how access to domestic medical education shapes physician supply, training location, timing of entry into practice, earnings, and other labor market outcomes.

Norway's centrally-administered and standardized admission algorithm provides us the basis for a regression discontinuity design; it creates quasi-experimental variation in access to domestic medical training around admission cutoffs, allowing us to compare applicants with observable and nearly identical qualifications who differ in their admission probability.

Comparing applicants just above and below the cutoff identifies the causal effect of admission for marginal applicants. We examine the impact of admission on outcomes such as enrollment in medicine, study abroad, completion of a medical degree, and labor market outcomes.

We find sizable effects of admission on educational and early-career outcomes. For marginal applicants whose enrollment decisions are affected by admission, access to domestic medical training substantially increases the probability of studying medicine in Norway and completing a medical degree, while reducing the likelihood of studying medicine abroad. At the same time, admission shifts individuals away from alternative adjustment margins–such as delaying enrollment, switching to other fields, or pursuing medical education abroad–thereby accelerating transitions into the labor market.

These differences translate into changes in early-career outcomes. Crossing the admission threshold increases the probability that a marginal applicant will practice medicine in Norway, but only by 24 percentage points. Even among the "compliers" for whom the admission threshold affects immediate enrollment outcomes (58 percent of marginal applicants), crossing the admission threshold and securing enrollment in Norwegian medical school increases the probability of practicing medicine in Norway by only 41 percentage points. This is because many students who fail to secure enrollment at a Norwegian medical school in the initial application cycle eventually make their way into–and graduate from–medical schools anyway. About 28 percent of compliers find their way into medical schools abroad (predominantly in Denmark) if rejected from Norwegian medical schools. Another 35 percent successfully engage in "credentialism" and secure enrollment in Norwegian medical schools in a later application cycle. For the students who engage in "credentialism," crossing the admission threshold *accelerates* entry into the physician labor force because some would not have secured their eventual enrollment years later–for some, as many as 5 years later.

Delayed studies (and consequently delayed labor force entry) are not the only social cost incurred when marginal medical school applicants are rejected. Rejection causes 8 percent of compliers to emigrate and live abroad even ten years later, whereas virtually all compliers continue to live in Norway if they receive an offer from a Norwegian medical school. This has consequences for long-run labor market outcomes: 10 years later, rejection reduces complier employment in Norway by 12 percentage points and total complier earnings in Norway by 24 percent. These effects are driven by emigration effects for some applicants compounding with delay and choice-of-degree effects for others.

This simple comparison around an admission threshold does not, however, isolate the effects of admission relative to any specific alternative available to applicants. Those just below the cutoff sort into several distinct paths: some "cooperate" with the admission rule, switch-

ing into other domestic fields of study that are lower on their preference rankings. Others "defect" from the central admission rule in two different ways: delaying their education in order to reapply in a later cycle or pursuing medical education abroad. These alternatives differ in both the nature of their eventual career trajectories and the timing of them. As a result, the group below the cutoff comprises a mixture of counterfactual paths, and the RD estimates reflect a weighted average of counterfactual-specific treatment effects, as observed in other recent work on multidimensional educational choice [Kirkebøen et al., 2016, Mountjoy, 2026].

With a single threshold instrument, it is not possible to point identify the effect of admission to medical school in Norway relative to any specific alternative. The relevant subgroups–those who would delay, switch fields, or study abroad if rejected–are not directly observed and are endogenously self-selected. We therefore derive bounds on the causal effect for these subgroups by combining partial identification methods of Lee [2009] with results on the identification of marginal distributions of complier outcomes from Abadie [2002].

The exercise reveals informative and stark differences in the effect of enrollment across complier subpopulations, even when we account for statistical uncertainty in the estimated bounds. Our estimated bounds indicate that the compliers who immediately enroll in Danish medical schools if rejected are–*when* rejected–46 to 51 percentage points less likely to live in Norway 10 years later. Accounting for statistical uncertainty, a 95 percent confidence interval on this effect ranges from 19 to 79 percentage points. Students who instead study medicine in other countries or who opt for non-medical studies almost always reside in Norway 10 years later.

The decision by Norwegian students to remain in Denmark after completing Danish medical studies appears to be a long-term one. Rejection also causes these students to reduce the rate at which they apply for authorization to practice medicine in Norway–a straightforward bureaucratic step that one must take in advance of returning to practice as a doctor. Our estimated bounds indicate that rejection causes authorization to fall by 33 to 34 percentage points, with a 95% confidence interval of 19 to 69 percentage points. We interpret this to mean that many of the Danish medical school enrollees do not intend to return to Norway in the near future. It points to enrollment among high-performing students in medical schools in Denmark–a neighboring country with a similar language and labor market opportunities–as a costly source for brain drain and an unreliable channel for producing doctors to supply the Norwegian health care system.

Taken together, the results imply that expanding domestic medical capacity would increase the number of domestically trained physicians, reduce delays in training and entry

into practice, and modestly mitigate the loss of applicants to foreign education and labor markets.

To our knowledge, this paper is the first to document "brain drain" effects of rejecting high-performing students from elite academic study programs, driven by students choosing to instead pursue those study programs abroad. These effects provide an additional motive for expanding access to elite study programs. Recent Norwegian reforms–expanding medical school capacity[1] and reserving more seats for first-time applicants[2]–suggest that policymakers may have recognized these costs. The domestic and international policy environment in which these effects arise for Norway is comparable to that faced by many other European countries. The same logic also extends to individual U.S. states, where restricted access to selective in-state programs may push students toward out-of-state study and, ultimately, out-of-state careers.

This paper contributes to several strands of the literature. First, it adds to the literature estimating the returns to admission to selective and capacity-constrained educational programs using quasi-experimental variation [Dale and Krueger, 2002, Hoekstra, 2009, Zimmerman, 2014, Goodman et al., 2017, Mountjoy, 2026]. While this literature focuses on the returns to admission for marginal applicants, we additionally examine how admission policies translate into the supply of physicians, linking educational access to workforce outcomes. We provide new evidence from a highly selective professional program and focus on outcomes directly related to labor supply.

Second, we contribute to a growing literature emphasizing that educational choices involve multiple margins of adjustment [Kirkebøen et al., 2016, Mountjoy, 2026]. In our setting, applicants adjust along several distinct paths–including delaying enrollment, switching fields, or pursuing medical education abroad–so that standard regression discontinuity estimates combine effects across these margins. We build on this insight by developing a bounding approach that isolates the effects associated with specific counterfactual alternatives, in particular domestic versus foreign medical training.

Third, we contribute to the literature on international education and skilled migration. Existing work shows that studying abroad can increase subsequent international mobility

[1] Kunnskapsdepartementet reports a record 900 medical school study places in 2026, an increase of 255 since 2021. https://www.regjeringen.no/no/aktuelt/kraftig-okning-i-sokingen-til-hoyere-utdanning/id3157089/

[2] Under reforms to the admission system taking effect for the 2028–2029 academic year, the first-time-diploma quota (*førstegangsvitnemål*) rises from 50 to 65 percent of seats, with the age limit extended from 21 to 23. https://www.samordnaopptak.no/universitet-og-hogskole/aktuelt/nye-regler-for-opptak-til-hoyere-utdanning.html

[Oosterbeek and Webbink, 2011, Parey and Waldinger, 2011, Di Pietro, 2012, Pinto, 2022], but provides limited evidence on how domestic admission constraints shape these decisions. We study a setting in which studying abroad is induced by capacity constraints in domestic medical education and examine how this affects subsequent location choices and the domestic supply of physicians.

2 Institutional setting

The number of medical graduates is an important indicator of the future supply of healthcare workers. In 2023, Norway was among countries with the lowest number of medical graduates per capita [OECD, 2025b]. This indicator for Norway is 10.8 per 100,000, compared to an OECD average of 14.3, Sweden's 13.5, and Denmark's 21.0. At the same time, Norway is far above the OECD average in the number of licensed medical practitioners per capita [OECD, 2025a]. The reason for this is that around 44% of medical practitioners in Norway are foreign-trained, which is also among the highest in OECD countries.

Due to concerns about the shortage of doctors, many OECD countries increased the number of admitted students to their medical schools. In 2019, the Grimstad Committee concluded in their report that Norway should educate 80% of its own medical professionals and recommended increasing the available study placements in Norwegian universities from 636 to 1076 by 2027 [Grimstadutvalget, 2019]. In 2026, the number of study places at Norwegian universities had increased substantially to 900.[3]

Enrollment at Norwegian medical schools was essentially flat over the decade prior to the Grimstad report; it remained at roughly 3,600 students from 2008 to 2018. Meanwhile, the number of Norwegian medical students abroad grew by roughly one third over that period, from roughly 2,400 enrollees to 3,200 enrollees.

2.1 Undergraduate medical training in Norway and the admission threshold

Studying medicine is a long-term commitment. In Norway it takes 6 years of university education at a minimum. There are four Norwegian universities which offer medical studies: the University of Oslo, the University of Tromsø, the University of Bergen and the Norwegian University of Science and Technology in Trondheim. None of the medical universities charge tuition fees. From 2007 through 2012, the years relevant for this paper, the increase in the

[3] https://www.regjeringen.no/no/aktuelt/kraftig-okning-i-sokingen-til-hoyere-utdanning/id3157089/

number of study spots was marginal (20 study places).

The number of applicants far exceeds available study places, making admission highly competitive. Applicants are ranked based on accumulated points and allocated seats through a centralized system with two main quotas: the "first-time" quota and the "regular" quota. Admission is determined by a cutoff in this ranking, which varies across cohorts depending on capacity and the distribution of applicant scores.

First-time applicants are subject to the special "first-time quota" within which they can compete only with other first-time applicants for admissions to medical school. Applicants must enter the first-time quota no later than the year in which they turn 21, and admissions through the "first-time" quota are based almost purely on academic criteria. By contrast, applicants in the "regular" quota are also ranked based on points from other factors such as age and military service. Half of the seats in medical schools are reserved for enrollment through the first-time quota.

In addition, the University of Tromsø operates special quotas for applicants from Northern Norway and the Sámi population. At this university, 60% of medical study places are reserved for individuals with a North Norwegian background, and six places are allocated to the Sámi quota. These additional quotas affect the allocation of study places and are taken into account in our empirical analysis. In our regression discontinuity design, applicants eligible for this quota will be among the "always-takers;" we will instead identify effects among applicants for whom crossing the main admission threshold causes an enrollment offer to arrive.

2.2 Undergraduate medical training abroad

How Norwegian students finance medical studies abroad depends on the destination. Access to Denmark is governed by the 1996 Nordic Agreement on Access to Higher Education, which resembles tuition reciprocity agreements that exist across U.S. states. The agreement entitles Nordic citizens to apply to another Nordic country's public higher education on the same terms as domestic applicants and, under Article 7, requires each sending country to pay the host country a fixed annual amount per student [Nordisk Ministerråd, 1996].[4]

Students who instead study medicine in non-Nordic countries such as Poland, Hungary, or Slovakia pay tuition directly to the institution, but can receive substantial individual support from Lånekassen, the Norwegian State Educational Loan Fund: a basic living-cost loan

[4]This reimbursement–originally 22,000 Danish kroner per student annually, raised to 26,000 in 2013 and 30,000 in 2014–covers only a fraction of the true cost of a medical education, estimated at roughly 100,000 Danish kroner per year, a shortfall that has been a recurring source of friction between the two governments. See https://www.nrk.no/norge/betaler-mer-for-studenter-i-danmark-1.8271201.

(partly converted to a grant on completion), a separate loan covering tuition fees at approved institutions (also partly grant-converted, more generously so at institutions Lånekassen designates for "extended" grant support), and travel support. Unlike the Danish case, no government-to-government payment is involved; the Norwegian state subsidizes the student directly, and periodically revises which foreign institutions qualify.

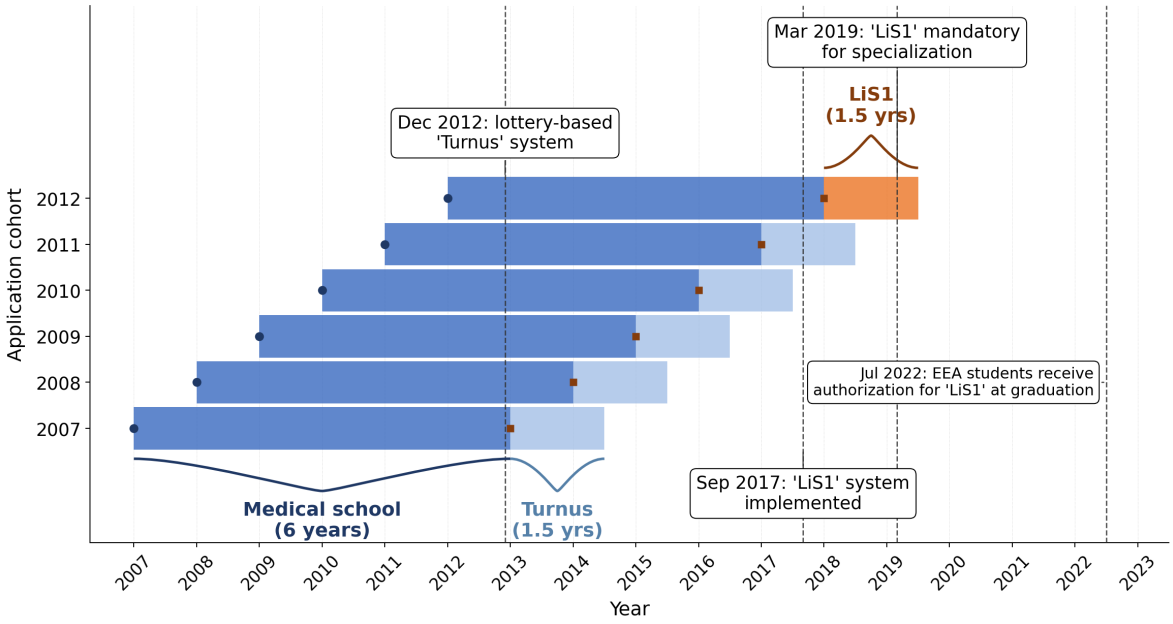
2.3 Postgraduate medical training in Norway

Norwegian postgraduate medical training has undergone some changes in the period 2013-2019. Until December 2012, graduation from a medical school in Norway was followed by a compulsory training (turnustjeneste, hereafter 'turnus'), which was part of a basic medical training and a prerequisite for receiving an authorization in Norway. In December 2012, the latter was changed so that an authorization was now granted upon graduation. The 'turnus' itself remained unaltered, but a new type of internship was under development until 2016 and was now meant as part of medical specialist training [Straume, 2022]. At the same time, the training slot allocation process was changed from a lottery-based system to an application-based one [Helsedirektoratet, IS-6/2015].

In 2017, 'turnus' was replaced by a 1.5-year internship called LiS1 (lege i spesialisering, del1), which became the first compulsory part of medical specialist training. Until March 2019, there was a transition period, which allowed approval of old 'turnus' or parts of it in some cases[5]. Since March 2019, 'turnus' was fully discontinued and LiS1 became a prerequisite for further specialization in Norway. Figure 1 visualizes these changes as a timeline.

[5] https://www.regjeringen.no/contentassets/3354cae20b43469991f5d19a4d17b4b5/rundskriv-i-2-2017_spesialistforskriften.pdf

Figure 1. Policy changes in Norwegian postgraduate medical training, relative to our application cohorts.



Making LiS1 a prerequisite for further specialization in Norway led to much debate concerning Norwegian students abroad, especially in Denmark as one of the most popular study destinations. The Danish medical education system consists of a 6-year program at a medical school followed by a one-year basic clinical training (hereafter 'KBU'; Gjessing et al., 2024). Since March 2019, Norwegian medical students in Denmark and other countries without integrated clinical practice were required to complete a basic clinical training in the country of study before they could apply for an authorization in Norway[6]. They were also required to complete LiS1 upon their return to Norway. Opponents of this requirement argued that it resulted in a double internship, as the basic clinical training from Denmark overlapped substantially with LiS1 from Norway, which meant inefficient use of scarce LiS1 spots in addition to a career delay for medical graduates from Denmark [Nmf, 2020]. Starting from July 2022, Norwegian medical students in EEA countries without integrated clinical training were allowed to receive an authorization in Norway without completing a basic medical training in the country of study[7]. This meant that Norwegian students in Denmark were also allowed to receive an authorization in Norway without completing KBU in Denmark. In addition, the government in Norway might agree on a basic clinical training (KBU) from Denmark or

[6]This requirement is applicable also for students in other countries without integrated clinical practice. The list of such countries can be found here: https://www.ansa.no/fag/medisinstudier/

[7]https://www.helsedirektoratet.no/nyheter/spesialistgodkjenning-for-leger-og-tannleger-med-norsk-a

similar foreign programs to be approved as equivalent to parts of LiS1 starting from 2026[8].

3 Identifying effects of immediately enrolling in medical school

That the admissions are offered as a deterministic function of applicants' scores makes this a natural setting in which to implement a regression discontinuity (RD) design. Earning just enough application points to cross the admission threshold can influence one's study choice (treatment) on two margins: it can change the timing of one's enrollment or change the place and field of study. So let $\mathbf{D} \equiv (M, I)$ denote one's potential assignment with destination and field of study M and enrollment status I. M can take on three potential values: studying medicine domestically ($M^{\text{D-Med}}$), studying medicine abroad ($M^{\text{F-Med}}$), and taking non-medical studies (M^{Other}). Enrollment status is binary: immediate ($I = 1$) and delayed ($I = 0$). We aim to study the effects of immediately studying medicine domestically, denoted $\mathbf{D}^1 \equiv (M^{\text{D-Med}}, 1)$, relative to an applicant's next-best option $\mathbf{D}^0 \neq \mathbf{D}^1$.

Crossing the admission threshold (Z) can potentially move an applicant's actual assignment ($\mathbf{D}(Z)$) from $\mathbf{D}^0$ to $\mathbf{D}^1$. But because crossing the threshold does not perfectly determine enrollment—some above do not immediately enroll, and some below still do—variation from the admission threshold can only identify effects for compliers, the set $\mathbb{C}$ for whom $\mathbf{D}(1) = \mathbf{D}^1$ and $\mathbf{D}(0) = \mathbf{D}^0$.

Using potential outcomes notation, we define the parameter of interest as

$$\tau \equiv E[Y(\mathbf{D}^1) - Y(\mathbf{D}^0) \mid \mathbb{C}], \tag{1}$$

where $Y(\mathbf{D}^1)$ and $Y(\mathbf{D}^0)$ denote the potential outcomes under the two relevant counterfactuals. For brevity, let $D \equiv \mathbb{1}\{\mathbf{D} = \mathbf{D}^1\}$ denote the indicator for immediate enrollment in a Norwegian medical school. The observed outcome is given by

$$Y = Y(\mathbf{D}^0) + (Y(\mathbf{D}^1) - Y(\mathbf{D}^0))D$$

Because crossing the admission threshold does not deterministically induce enrollment, the design corresponds to a fuzzy RD. Within the local randomization window, identification can therefore be implemented using an instrumental variables (IV) approach, where crossing the threshold serves as an instrument for treatment.

Underlying our design are four standard IV assumptions. Being a regression discontinuity

[8] https://www.legeforeningen.no/nyheter/2025/dansk-kbu-kan-gi-lis1-godkjenning/

design, each of these assumptions must hold for applicants at the margin of the admission threshold for domestic medical school. First we impose the following exogeneity assumption:

Assumption 1 (Exclusion). *$Y(\mathbf{D}^1, Z)$ and $Y(\mathbf{D}^0, Z)$ are not functions of Z*

This assumption is built into our notation, that outcomes depend only on one's assignment and not directly on one's position above versus below the admission cutoff. It rules out that crossing the admission threshold directly affects outcomes without operating through enrollment in a Norwegian medical school.

Assumption 2 (Random Assignment). $Y(\mathbf{D}^1), Y(\mathbf{D}^0), \mathbf{D}(1), \mathbf{D}(0) \perp Z \quad$ *given* $R = c$

This means that crossing the admission threshold is unrelated to unobserved determinants of assignment and outcomes. In our setting, this holds if applicants cannot precisely manipulate their application points to sort around the cutoff. The evidence presented in Section 4.2 supports this aspect of the assumption.

We next impose a monotonicity assumption, requiring that crossing the admission threshold only causes applicants to change their assignment to immediately enroll in domestic medical school–and does not cause them to change to any other alternative.

Assumption 3 (Monotonicity). $P(\mathbb{1}\{\mathbf{D}(1) = \mathbf{D}\} > \mathbb{1}\{\mathbf{D}(0) = \mathbf{D}\}) = 0 \quad$ *for* $\mathbf{D} \neq \mathbf{D}^1$.

Because we focus on the assignment to *immediate* enrollment, this assumption imposes restrictions not just on how Z affects one's choice of degree program but also on the timing of that choice. It rules out that crossing the admission threshold causes students to delay their studies or switch between other study programs. Note that these behaviors would represent violations of Exclusion in a more conventional treatment effect framework where we take enrollment in domestic medical school (regardless of its timing) as the treatment. In that framework, changes in enrollment timing or switching between non-medical degrees would be channels by which the admission threshold can affect outcomes without affecting treatment.

Finally, the instrument must be relevant, meaning that crossing the threshold increases the probability of treatment.

Assumption 4 (Instrument Relevance). $P(\mathbb{1}\{\mathbf{D}(1) = \mathbf{D}^1\} > \mathbb{1}\{\mathbf{D}(0) = \mathbf{D}^1\}) > 0$

This assumption is testable, and as we show in Section 4.2 (Figure 2), the first stage is strong, and the corresponding F-statistic exceeds rule-of-thumb thresholds.

4 Data, estimation strategy, and diagnostics

Our analysis uses administrative data from several sources to investigate how receiving an offer from, enrolling in, and graduating from a Norwegian medical school affects later labor market outcomes, including income and the probability of working as a medical doctor. We focus on all first-time applicants who listed medicine as their top-choice program between 2007 and 2012, and for whom we observe a set of baseline observable characteristics.[9] Using a unique personal identifier, we link these individuals to other administrative records, enabling us to gather detailed information on their family background and follow their long-term career trajectories.

The "first-time quota" applicants are a subpopulation for whom our quasi-experimental design is simpler and plausibly more credible: an individual appears in this design only once, and an individual has little incentive to strategically manipulate the timing of his or her application. Among admitted students through the first-time quota, 99 percent ranked medicine as their top choice program.

Individual socio-economic characteristics are obtained from the Norwegian population register. These characteristics cover parental education level and whether the parent(s) have a medical degree, the individual's immigration status, parental income, and the centrality of the municipality of residence at age 16. All these characteristics are pre-determined in our analysis. Parental income is measured as an average sum of mother's and father's income when their child was 10-18 years old, adjusted for the Consumer Price Index with 2015 as a base year. It is also transformed into income percentile ranks, which correspond to one's position relative to others born the same year.

The national education register provides information on application and outcome variables, tracking individual education histories up to 2020 for the cohorts in our sample. This data includes the year of enrollment and completion, the level and field of education, and the country where the education was pursued. These details enable us to distinguish between medical degrees obtained in Norway and those earned abroad, as well as education in other fields.

The Norwegian tax registers provide detailed data on earnings, encompassing both wage

[9] Those characteristics are birth year, immigration status, sex, parental education, and parental income ranks. In addition, we must observe upper secondary school certificates to impute specialization points ("fordypningspoenger"), which are missing for some applicants in our first two cohorts. Excluding individuals with missing values of observables and missing specialization points excludes at most 6.7 percent of first-time applicants listing medicine as a top choice who, in truth, fell within our bandwidth around the admission threshold. We lose 4 percent of them from missing observables alone.

income and self-employment income. In our main analysis, earnings are examined alongside key indicators of labor market transitions, such as unemployment status and residency abroad. We also focus on career outcomes specific to medical graduates, including practicing medicine. These outcomes are constructed as binary variables using information from administrative tax and employment registers.

To identify individuals staying abroad two years after graduation, we follow a simplified version of Statistics Norway's approach to capture unregistered emigration. Since many individuals do not officially report their stays abroad, we infer emigration by checking whether occupation, industry, income, or any other monetary transfers are missing for two consecutive years post-graduation.

Unless otherwise specified, outcomes are assessed ten years following the application year, by which time the majority of individuals have transitioned from education to employment.

4.1 Estimation

Our approach to the regression discontinuity design restricts attention to individuals whose application score R falls within some window W around the cutoff, which lies at $R = 0$.

We estimate the following instrumental variables system:

$$\begin{aligned} Y_i &= \beta_0 + \beta_1 D_i + \beta_2 R_i + \beta_3 Z_i \times R_i + \eta_i \\ D_i &= \gamma_0 + \gamma_1 Z_i + \gamma_2 R_i + \gamma_3 Z_i \times R_i + \varepsilon_i \end{aligned} \tag{2}$$

where $Z = \mathbb{1}[R \geq 0]$ is an indicator for crossing the admission threshold. We include linear trends in the running variable on both sides of the cutoff to account for the potential effect of one's application score on outcomes that can operate beyond the admission threshold. Key to our design, though, we must assume that expectations are smooth functions of the application score on either side of the admission threshold.

To construct D_i, we consider an applicant as "immediately enrolled" if he or she enrolls in a study program within one year and, if in a non-medical study program, *stops applying* for medical programs by the end of that period as well. Our intent is to rule out as "immediately enrolled" applicants whose outcomes might be affected by either delayed enrollment in their final study program or costly but unobservable actions taken in pursuit of studying medicine in later application cycles.[10]

[10]Since completion of university courses is rewarded by additional application points, students may enroll in a non-medical study program with no intent of completing it. We categorize such individuals as 'delayers', if

The existence of grade appeals and wait lists means that moving exactly across the admission threshold changes the first-round enrollment for only a narrow set of applicants: those who do not successfully appeal for a grade improvement, who opt onto a wait list (supposing the wait list is utilized), and who are old enough to beat any otherwise-identical applicants on a tie-breaker for an enrollment slot. Instead, we broaden our set of compliers by explicitly relying on a small–but not vanishingly small–amount of random variation in applicant scores. So our baseline strategy uses a two-sided donut that includes applicants within 5 points of the threshold but excludes those within 0.2 points. We view our complier population to be those who would not receive an admission offer if below the threshold *and unable to easily appeal their outcome*, but would receive an offer *without* having to opt into a wait list.

Medical school admissions are highly competitive in Norway and our donut is narrowly focused around the admission threshold, so that even the worst-performing students we study are still high-performing in absolute terms. The radius of our window around the admission threshold corresponds to 0.7 standard deviations in the point distribution. Even students who are 5 points below the lowest admission threshold to medical schools in Norway–just enough to be included in our estimation sample–are in the top 15 percent of all first-time applicants to study programs with admission based solely on application scores. The admission threshold tends to be close to the maximum score a student could possibly obtain, so almost zero applicants are excluded for having a score *too high* above that threshold. Nearly all the students close to the admission threshold eventually pursue higher education; only 1.5% have no registration in the 8 years since their first application.

4.2 Admission thresholds and RD diagnostics

Since we focus on first-time applicants with no prior degrees, most of our sample (94%) is ranked according to the first quota criteria. Applicants who apply to multiple universities are assigned an admission threshold corresponding to the lowest cutoff among the universities they list. To standardize application points, we subtract the relevant admission threshold so that the cutoff is normalized to zero.

Applicants who do not meet the admission threshold may still enter medical school: either through the special quotas, by appealing the grades determining one's application score, or

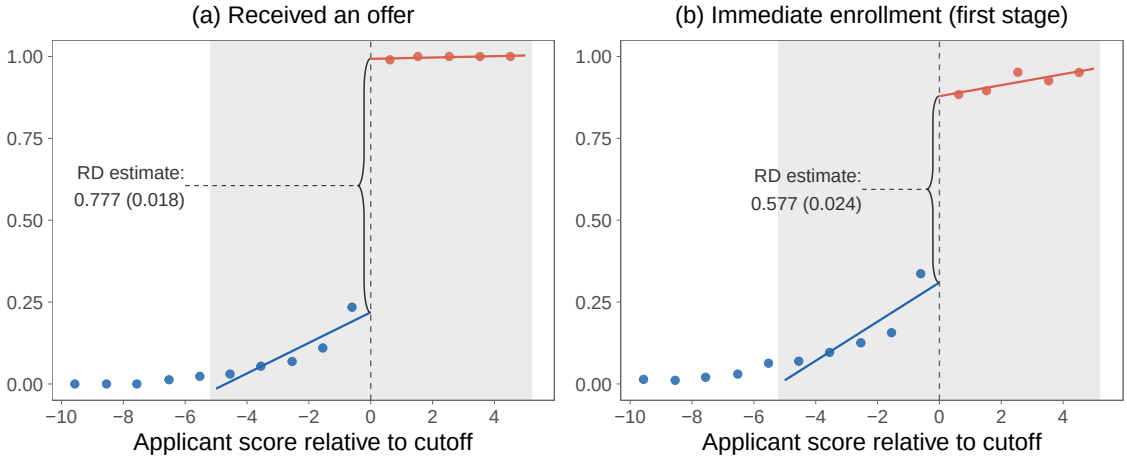
we observe that they reapply to medical schools in Norway *in more than one year* after their initial application. More than 50 percent of these applicants end up in domestic medicine programs eventually. We allow one year of study in another program because it is common for students to transfer into medicine with credit for first-year courses from other programs of study, especially dentistry and nutrition. Such an arrangement likely does not delay one's degree completion substantially. See Appendix B for details.

through late-arriving offers intended to fill unexpectedly-vacant program slots. Additionally, students can accrue more application points and gain admission in a subsequent selection round, via the "regular" quota.

Conversely, some applicants at or above the admission threshold may not receive offers. At the threshold, this can be due to ties between applicants, which are broken according to birth order. Even above the threshold, some applicants may not receive an offer if they did not opt onto a waitlist; the admission threshold we observe corresponds to the score one would need to receive as a candidate on that waitlist, not the score necessary for a first-round offer. All this implies that the admission threshold functions as a *fuzzy cutoff* for enrollment. Figures 2–4 present three key diagnostics supporting a fuzzy regression discontinuity design.

Figure 2 shows a sharp discontinuity in opportunities and enrollment in a Norwegian medical school at the application threshold. Panels (a) and (b) examine the effects of crossing the threshold on receiving an offer and enrolling within 1 year, respectively ("immediate enrollment"). Panel (b) shows that crossing the admission threshold increases the probability of immediately enrolling in medical school–the first stage in our regression discontinuity design–by 58 percentage points. Note that when measuring that increase in immediate enrollment, we do not require that one received an enrollment offer in this application cycle. This is simply to allow for possible measurement error in offers of enrollment; Appendix Figure A1 shows that we find similar shifts in take-up if we focus only on take-up that follows a formal offer of admission.

Figure 2. The effect of the admission threshold crossing on offer receipt versus enrollment (within 1 year) in medical studies in Norway

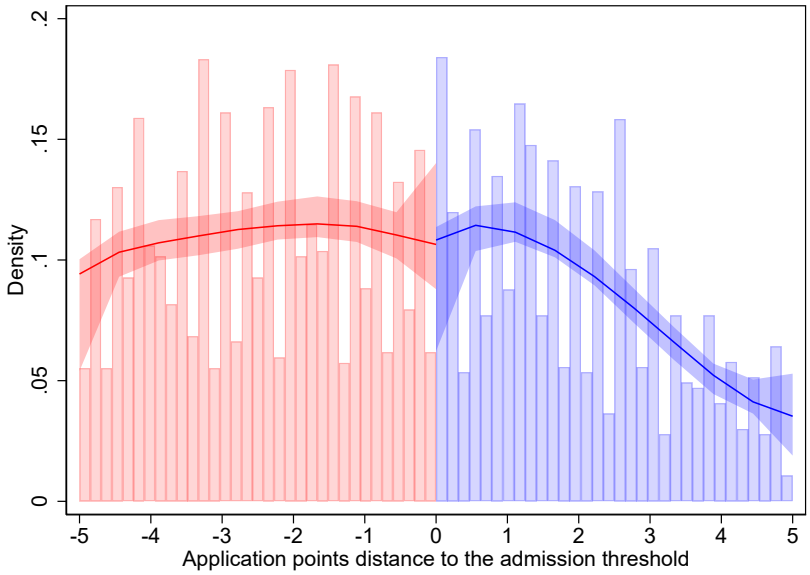


Notes: Across the five enrollment cohorts covering 2007-2012, applicants eligible for a special quota could have been admitted with application points 5.2, 3.9, 3.6, 2.3, and 4.2 points below the designated threshold respectively. The gray region indicates scores that could have led to a special quota admission in the most lenient year–5.2 points below the threshold. The estimates are based on the local linear RD estimator with a uniform kernel function, a bandwidth of 5 application points, and a donut of 0.2 points.

A potential threat to the regression discontinuity design is that applicants may be able to strategically sort around the admission threshold. To assess this, we examine the density of applicants and their observable characteristics for discontinuities. Figure 3 shows a smooth density of applicants around the threshold, indicating no evidence of sorting. This is confirmed by the formal density tests of McCrary [2008] and Cattaneo et al. [2018, 2020], which fail to reject the null of no manipulation at a 95 percent confidence level.

Institutional features of the admission system further support this finding. Admission thresholds are not known to applicants in advance and vary across years depending on capacity and the distribution of applicant scores. While applicants may form expectations based on previous years, these thresholds are determined endogenously and apply uniformly to all applicants. Moreover, application points reflect academic performance over all three years of upper-secondary education, limiting the scope for short-run manipulation of scores around the cutoff.

Figure 3. The density of applicants around the admission threshold. Sorting.

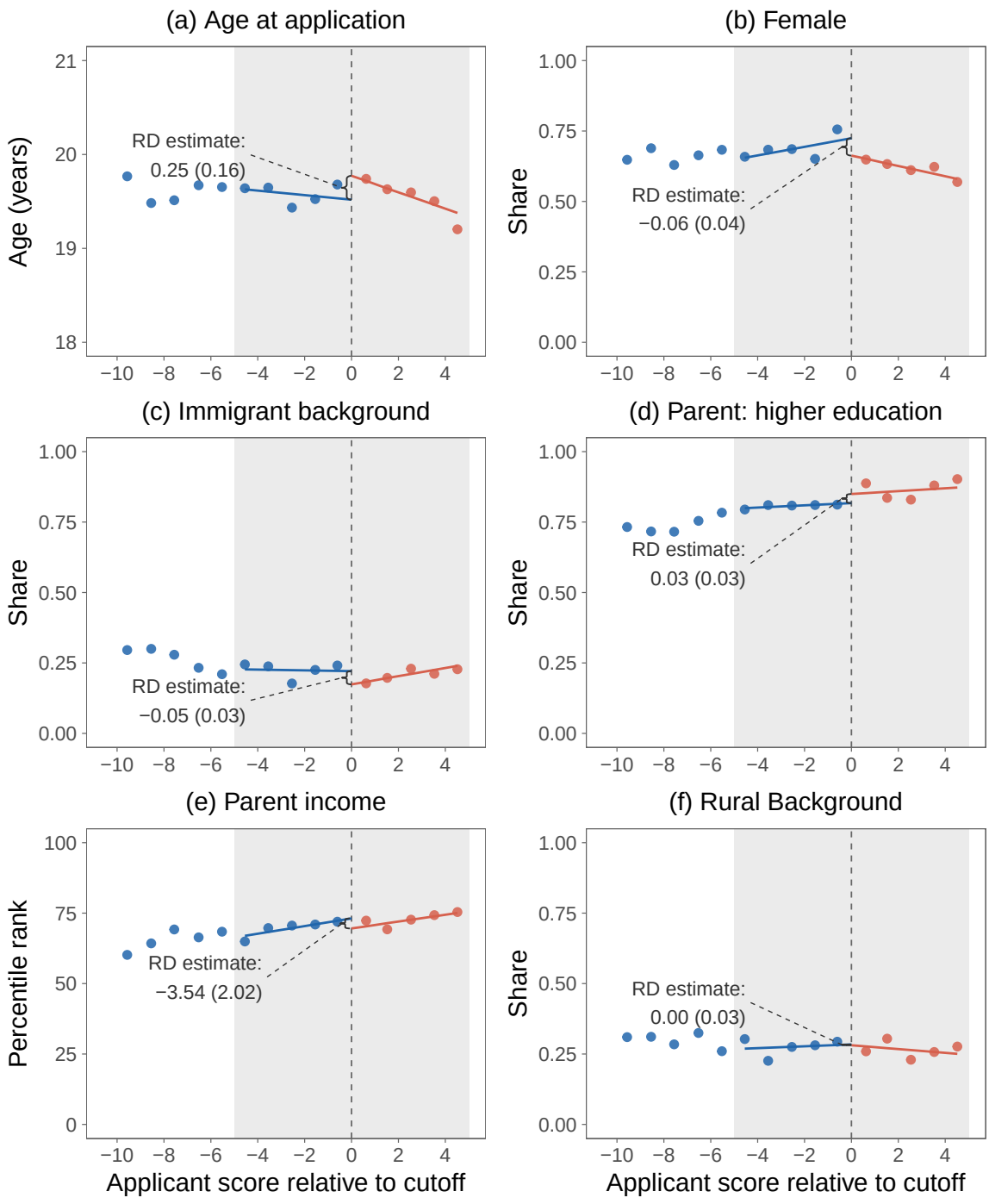


Note: The non-parametric kernel density estimator uses a quadratic local polynomial and a triangular kernel, with a bandwidth of 2.3 automatically selected using the method of Cattaneo et al. [2018]. Shaded regions denote 95 percent confidence intervals.

To further assess the validity of the research design, we examine covariate balance around the admission threshold. Figure 4 shows no evidence of discontinuities in predetermined characteristics at the cutoff. In particular, applicants just below and above the threshold are similar in terms of sex, age, parental education, parental income percentile, immigration status, and an indicator for having at least one parent with a medical degree.

Appendix Figure A2 further reinforces the exogeneity of the application score in a local area around the admission threshold, showing how application behaviors vary across it. Since we aggregate over many thresholds across different years and programs, individuals could choose when and where to apply such that they manage to secure an offer. Panel (a) of Figure A2 presents evidence against that concern, showing that applicants marginally above versus below their chosen admission threshold are indeed facing equally-stringent admission thresholds. The remaining panels of Figure A2 show that applicants above versus below the admission threshold tend to submit similar preference rankings over programs as well.

Figure 4. Covariate balance around the admission threshold



Note: "ITT" estimates and their standard errors in parentheses provide a balance test for the covariate presented in each panel. These are based on the local linear RD estimator with a uniform kernel and bandwidth of 5 application points. "Rural" means one lived at age 16 in a municipality at roughly the bottom tercile of the population-weighted centrality distribution, as determined by Statistics Norway's centrality index.

5 Results

In this section, we report the estimated effects of crossing an admission threshold as well as complier effects of enrolling in medical school in Norway on various educational and labor market outcomes. Figures in this section show the results of the estimation from the baseline specification described in subsection 4.1.

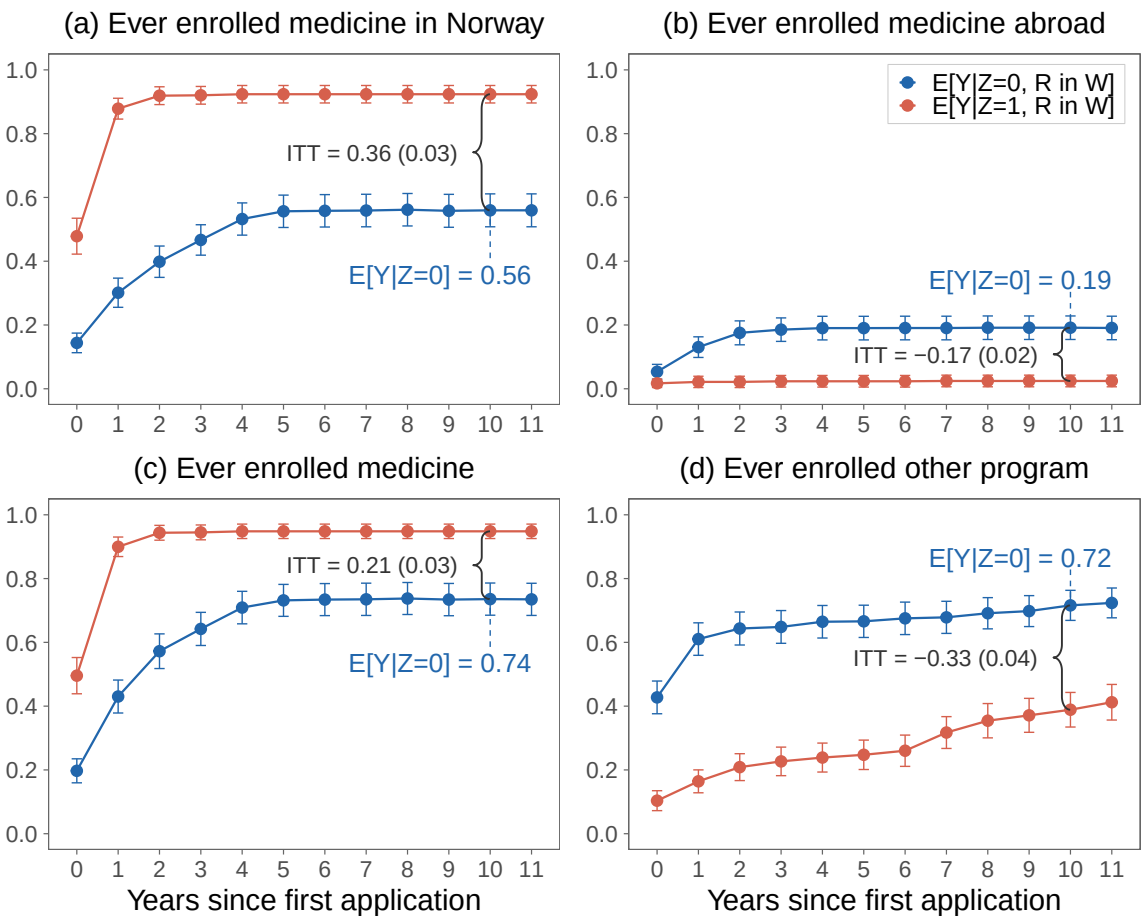
5.1 Educational outcomes

Figures 5 and 6 graph the intention-to-treat (ITT) effect of crossing the admission threshold to medical school in Norway on enrollment and graduation by year after the initial application. Appendix Figures A3 and A4 report the local average treatment effects (LATE) and graph corresponding outcomes for treated and untreated compliers. The effect for compliers is calculated by dividing the reduced form effect by the first-stage effect presented in Panel (b) of Figure 2.

Figures 5 and 6 illustrate to what extent barely missing the admission threshold to a medical school in Norway shifts the three response margins by which we might expect effects to arise: the timing of one's studies, one's choice of field, and whether one studies abroad or in Norway.

Both figures show that crossing the admission threshold has a significant effect on short-term and long-term education outcomes. Figure 5 shows that falling slightly below the admission threshold reduces the likelihood of ever enrolling in medical studies either in Norway or abroad at some point during the first 10 years since the initial application by 21 percentage points. Moreover, Panel a of Figure 5 also shows that falling barely below the admission threshold shifts the *timing* of one's medical schooling. The share of applicants just below the threshold who enroll into medical school in Norway gradually increases during the first 5 years, from below 20 percent in the year of applying to 56 percent. This suggests that these individuals continue to reapply and get admission to medical schools in Norway. Panel b of Figure 5 shows that falling just below the admission threshold increases the likelihood of studying medicine abroad by around 17 percentage points. Together, panels a and b establish that academically marginal individuals are more likely to eventually study medicine in Norway than to pursue medical education abroad, even if rejected from Norwegian medical schools in their first application cycle.

Figure 5. Educational outcomes (enrollment)

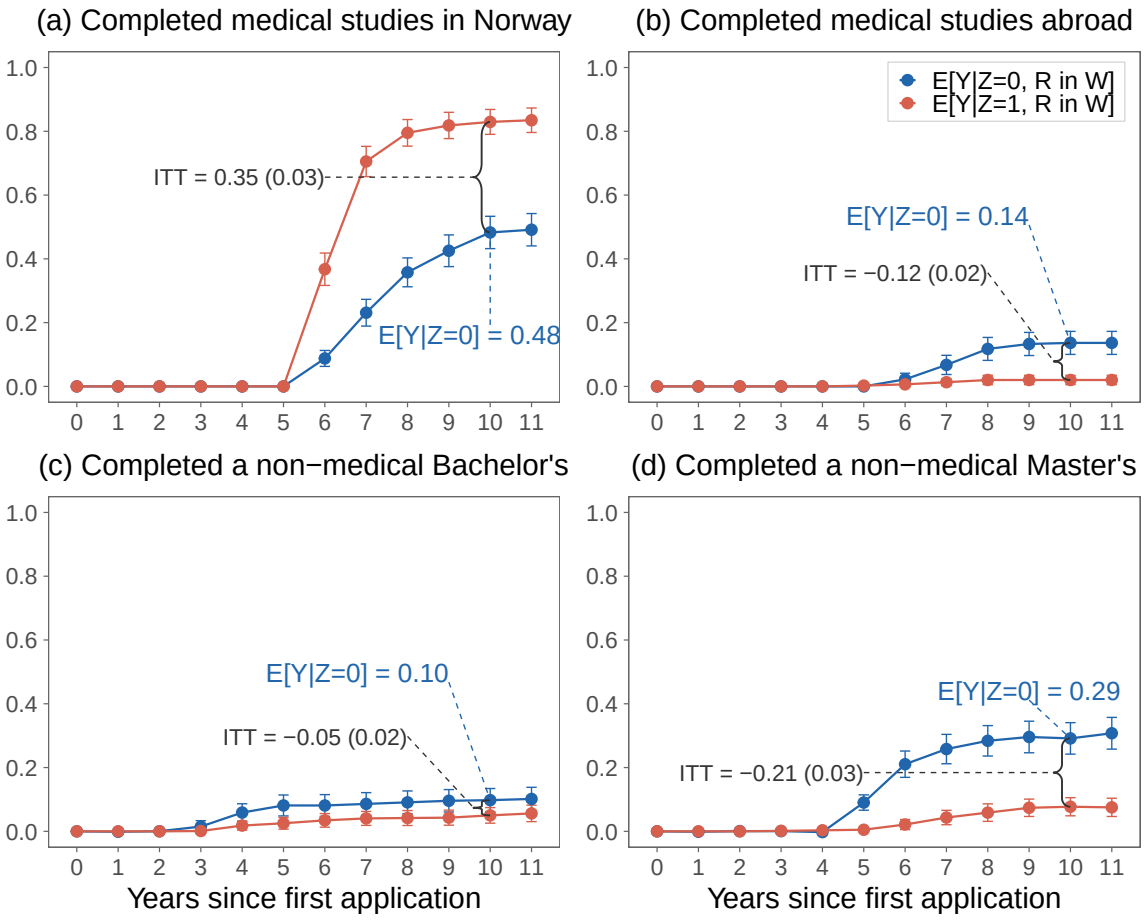


Note: The confidence intervals are calculated using bootstrap and are at the 95% confidence level. Panel d shows the outcomes of ever enrolling in another program and never enrolling in medical school.

Figure 6 shows how crossing the admission threshold affects the likelihood of degree completion by year after the initial application. Panels a and b suggest that individuals who fall just above the admission threshold are 35 percentage points more likely to graduate from a medical school in Norway and 12 percentage points less likely to graduate from a medical school abroad 10 years after the initial application. Panels c and d show that applicants below the admission threshold are only 26 percentage points more likely to complete a non-medical program (21 percentage points from master's degrees and 5 from bachelor's degrees alone). Scaling by the first stage (58 percent of marginal applicants), that estimate implies only 45 percent of compliers are induced into completing *some* non-medical degree when they are rejected from Norwegian medical schools. As one might expect, Appendix Figure A5 shows that falling below the admission threshold does not cause anyone to forego the completion of

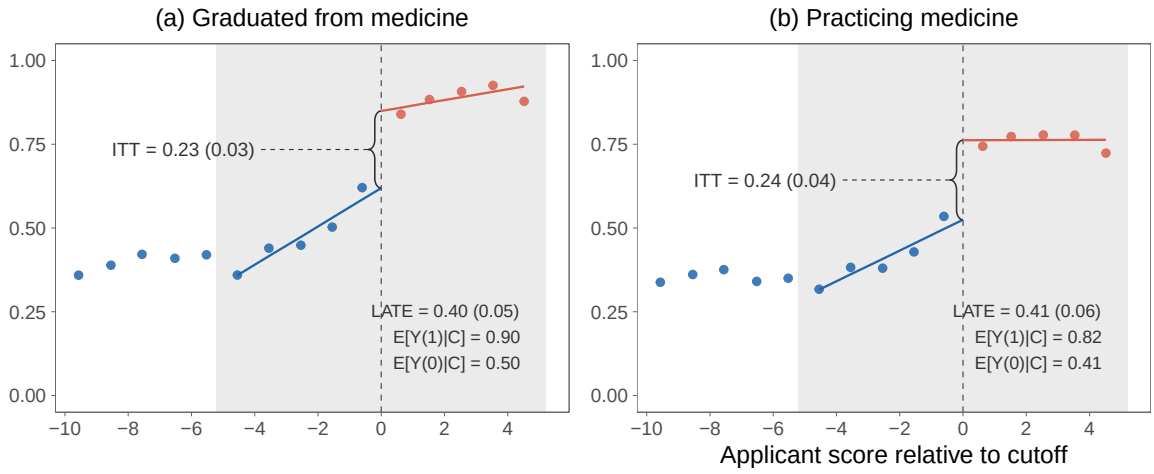
a college degree completely.

Figure 6. Effect of threshold crossing on degree completion



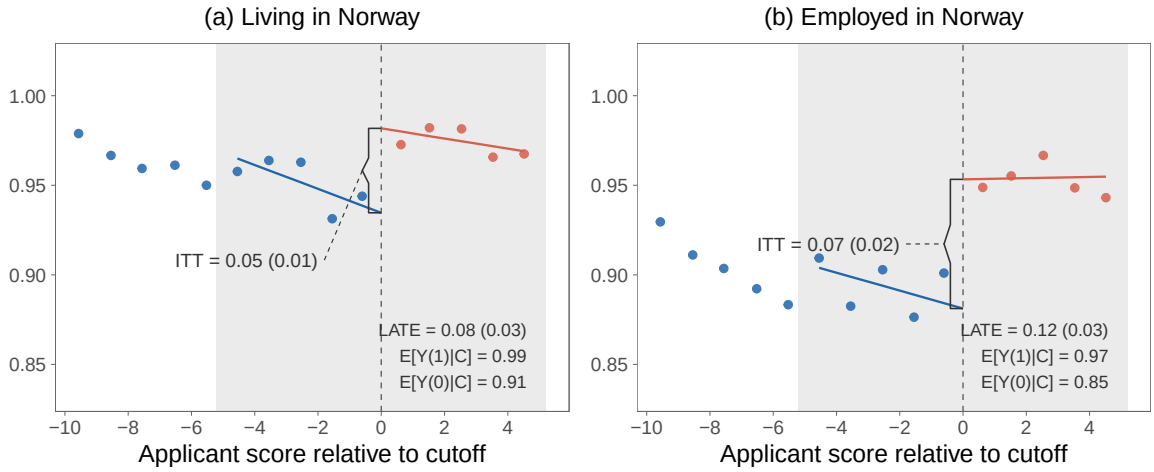
Note: The confidence intervals are calculated using bootstrap and are at the 95% confidence level. Individuals who completed both a master's and a bachelor's non-medical program during these 10 years post-application are recorded as having a non-medical master's degree.

Figure 7. Effect of threshold crossing on medical training 10 years later



Note: The parameters for compliers are calculated using Abadie's method [Abadie, 2002].

Figure 8. The effect of threshold crossing on living and working in Norway 10 years later



Note: We proxy for Living in Norway using receipt of *some* work income or transfers in Norway. That can include some individuals enrolled in study programs abroad, but that is rare 10 years post-application.

5.2 Supply of medical practitioners

To investigate how increasing the number of medical school slots in Norway would influence the overall supply of medical practitioners, we report the causal effects of crossing the admission threshold to medical schools in Norway on graduating and practicing medicine in

Norway 10 years after the initial application. Figure 7 shows that the likelihood of practicing medicine in Norway is 24 percentage points higher for applicants who score just above the admission threshold. We also find that the enrollment gap between individuals just above and just below the threshold is smaller, at approximately 21 percentage points. This suggests that, at most, we shift one student into medical practice in the long-run for every five enrollment offers made at the admission threshold.

5.3 Brain drain

Panel a of Figure 8 shows that being just above the admission threshold increases the likelihood of living in Norway by 5 percentage points ten years after the initial application. This finding suggests that limited access to medical education in Norway may contribute to a loss of highly qualified individuals from the country, at least in the medium term. Alternatively, it may indicate that some individuals who study medicine abroad have not yet returned to the domestic labor market.

5.4 Employment and earnings

Finally, Figure A6 shows that crossing the admission threshold increases earnings 10 years after the initial application, while Panel b of Figure 8 shows it increases the likelihood of being employed in Norway.

6 Identifying and estimating effects for complier subpopulations

The LATE estimates reported so far integrate over different complier subgroups. For some compliers, the effect of admission comes purely from changing their choice of study program. For other students who would delay their studies if rejected from medical schools, admission instead spares them from incurring the cost of those delays. The effect of changing one's study program versus delaying one's studies (or doing both) are likely different. Our next task is to assess what we can learn about separate treatment effects for these complier subgroups.

We can conceptually distinguish between three kinds of complier subgroups based on their counterfactual choices when falling below the admission threshold (i.e., when rejected from domestic medical school):

Always-enrollers

1. **Field-switchers**, $(M(0), I(0)) = (M^{\text{Other}}, 1)$: Rejection shifts applicants to immediately enrolling in some non-medical program.
2. **Country-switchers**, $(M(0), I(0)) = (M^{\text{F-Med}}, 1)$: Rejection shifts applicants to immediately studying medicine in a foreign country.
3. **Delayers**, $(M(0), I(0)) = (\cdot, 0)$: Rejection shifts the timing of one's studies, regardless of ultimate program choice.

Defectors

The country-switchers and delayers together compose the "**defectors**:" compliers who if rejected from medical school will "defect" from the central allocation scheme and opt for a study choice it does not administer. The country-switchers and the field-switchers together make up the "**always-enrollers**:" compliers who immediately enroll in some study program if rejected from medical school.

The country-switchers are an interesting subgroup because crossing the admission threshold does not change the field or timing of their study, only the place in which it takes place. We can further partition country-switchers into more granular subgroups based on their chosen destination abroad. At the threshold, Denmark is the predominant destination for medical studies abroad, and we call the compliers who would study medicine in Denmark below the admission threshold the **Denmark-switchers**.

The always-enrollers are a subgroup of particular interest to us for two reasons. First, changes in their expected outcomes will be driven purely by the change in one's choice of program and not study delays. Second, their post-education outcomes are plausibly observable by the end of our panel.[11]

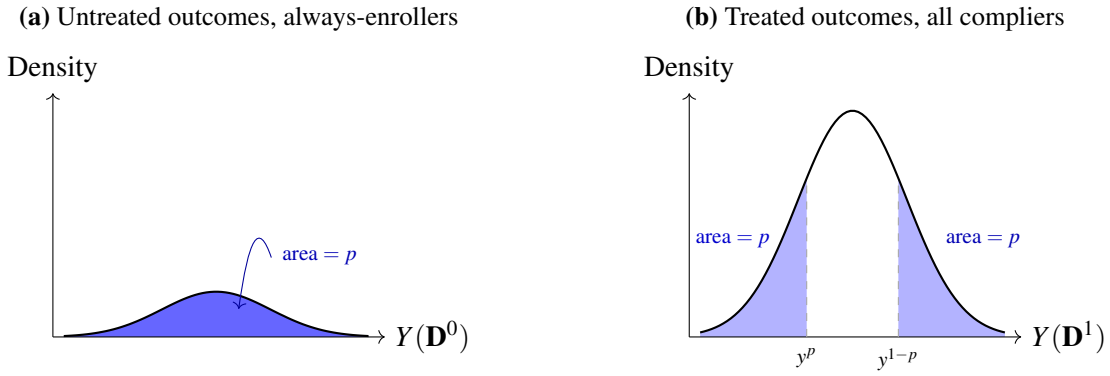
For these and any other subgroup defined by realizations of $M(0)$ and $I(0)$, our identification strategy is the same. Consider for instance the average treatment effect for always-enrollers:

$$\lambda_{\text{always-enroller}} \equiv E[Y(\mathbf{D}^1)|I(0)=1,\mathbb{C}] - E[Y(\mathbf{D}^0)|I(0)=1,\mathbb{C}] \tag{3}$$

We will identify $\lambda_{\text{always-enroller}}$ by separately handling the treated and untreated expectations which determine it. The key challenge we face is that we do not observe counterfactual enrollment choices (i.e., $I(0)$ when $Z=1$), which is a barrier to point identifying

[11] By contrast, students who delay their enrollment will also tend to delay the completion of their studies. For some applicant cohorts, post-graduation outcomes of delayers will be unobservable.

Figure 9. Illustrating the strategy for bounds on always-enroller treated expected outcomes



$E[Y(\mathbf{D}^1)|I(0)=1,\mathbb{C}]$ without further assumptions. We instead take a partial identification approach, which relies only on our stated LATE assumptions.[12]

Our partial identification approach involves combining methods for identifying marginal distributions of complier characteristics from Abadie [2002] with methods for worst-case bounds from Lee [2009]. [13] Because these groups are characterized by the choices they make when rejected from medical school (i.e., when untreated), we show that we can identify the marginal distribution of *untreated* outcomes for always-enrollers (and for any of the three complier subgroups individually) by Assumption 3. We use a complier-revelation method adapted from Abadie [2002] to do this.

To partially identify $\lambda_{\text{always-enroller}}$, we next need concern ourselves with the treated expectation $E[Y(\mathbf{D}^1)|I(0)=1,\mathbb{C}]$. While we cannot point identify this expectation, we know from Abadie [2002] alone that the marginal distribution of treated outcomes for compliers is identified. We can also use that method to identify the fraction p of compliers who are always-enrollers. That implies the following bounds on the treated expectation:

$$E[Y(\mathbf{D}^1) \mid \mathbb{C}, Y(\mathbf{D}^1) \leq y^p] \;\leq\; E[Y(\mathbf{D}^1) \mid I(0)=1,\mathbb{C}] \;\leq\; E[Y(\mathbf{D}^1) \mid \mathbb{C}, Y(\mathbf{D}^1) \geq y^{1-p}],$$

We also illustrate our partial identification strategy in Figure 9. Panel (a) depicts the identified untreated marginal distribution for the always-enrollers, scaled by their share among

[12] Our monotonicity condition rules out the existence of two nuisance groups of applicants who could threaten identification: "defying-enrollers" who immediately enroll in some program when *rejected* from domestic medical school but delay if admitted, and "irrelevant-alternative-enrollers" who immediately enroll only when admitted to domestic medical school, but *not in* domestic medical school.

[13] Mountjoy [2026] resolves a similar identification problem using stronger assumptions (and therefore tighter bounds) when studying effects of university enrollment on students with versus without enrollment in a less selective university as their next best options.

compliers p. Panel (b) depicts the identified treated marginal distribution for compliers. We bound always-enroller expectations in Panel (b) using the method of Lee [2009]: we suppose always-enrollers represent the top p fraction (for an upper bound) and the bottom p fraction (for a lower bound) in the treated outcome distribution for compliers. Taking expectations and differencing this upper and lower bound from the expected untreated outcome via Panel (a) then delivers upper and lower bounds on $\lambda_{\text{always-enroller}}$. We lay out proofs and other details in Appendix C.

6.1 Estimating bounds in the data.

To estimate the bounds on $\lambda_{\text{always-enroller}}$, we must first estimate p and the pth and $(1-p)$th quantiles of the treated outcome distribution (y^p and y^{1-p}). Each of these parameters can be estimated using our regression discontinuity design, after interacting both the outcome and treatment with I. To estimate y^p and y^{1-p} given an estimate for p, we use $\mathbb{1}\{Y(\mathbf{D}^1) < y\}$ as our outcome, which means the RD returns an estimate for $E[\mathbb{1}\{Y(\mathbf{D}^1) < y\}|\mathbb{C}]$, which is an estimate for the CDF of $Y(\mathbf{D}^1)$ among compliers, evaluated at y. We then find the smallest y for which $\hat{E}[\mathbb{1}\{Y(\mathbf{D}^1) < y\}|\mathbb{C}] = \hat{p}$ and $\hat{E}[\mathbb{1}\{Y(\mathbf{D}^1) < y\}|\mathbb{C}] = 1-\hat{p}$ respectively, denoting their estimates $\widehat{y^{\hat{p}}}$ and $\widehat{y^{1-\hat{p}}}$. To estimate the bounds, we restrict to observations with outcomes below $\widehat{y^{\hat{p}}}$ and above $\widehat{y^{1-\hat{p}}}$ for the lower and upper bounds respectively, then implement the RD estimator.

6.2 Descriptive statistics

To better understand complier subpopulations, we next examine descriptive statistics on different types of untreated compliers (the compliers for whom we observe next-best alternatives to Norwegian medical school). We subdivide them into two field categories, 'medicine' and 'educational fields other than medicine'. The former group is further divided by country/region of study, e.g. Norway, Denmark, Eastern Europe, and other countries[14]. Our analytical sample consists only of individuals in 5 application points distance to the threshold, however for the purpose of this Section, we also provide descriptive statistics for individuals further away from the threshold. We next briefly discuss each table and highlight the key points.

Table 1 consists of three panels. Panel A presents the total number of individuals above and below the admission threshold subdivided by the application points distance to the thresh-

[14]This division is guided by group sizes and known popularity of destinations among Norwegian medical students abroad.

Table 1. Descriptive statistics

Score Band:	<-5	[-5, -0.2]	[0.2, 5]	>5	
Panel A: Sample sizes by score band					
Sample count	1,671	1,680	1,196	77	
Panel B: Enrollment shares by score band					
Immediate enrollers:					
Med in Norway	0.02	0.15	0.92	0.87	
Med in Denmark	0.02	0.04	0.01	0.03	
Med in Eastern Europe	0.23	0.10	0.00	0.00	
Med in other countries	0.02	0.01	0.00	0.00	
Other in Norway	0.16	0.17	0.02	0.01	
Delayers:					
Med in Norway	0.11	0.19	0.03	0.04	
Med in Denmark	0.01	0.02	0.00	0.00	
Med in Eastern Europe	0.06	0.03	0.00	0.00	
Med in other countries	0.00	0.00	0.00	0.00	
Other in Norway	0.34	0.26	0.02	0.01	
No enrollment	0.00	0.00	0.00	0.00	
Margin:		$Z=0$	$Z=1$	DIFF	Complier share
Panel C: Enrollment shares at the admission threshold					
Immediate enrollers:					
Med in Norway		0.30	**0.88**	0.58	1.00
Med in Denmark		**0.08**	0.02	-0.06	0.10
Med in Eastern Europe		**0.03**	0.00	-0.03	0.05
Med in other countries		**0.02**	0.00	-0.02	0.04
Other in Norway		**0.14**	0.02	-0.12	0.20
Delayers:					
Med in Norway		**0.25**	0.05	-0.20	0.35
Med in Denmark		**0.04**	0.00	-0.04	0.06
Med in Eastern Europe		**0.01**	0.00	-0.01	0.02
Med in other countries		**0.01**	0.00	-0.01	0.01
Other in Norway		**0.12**	0.03	-0.09	0.16
No enrollment		**0.00**	0.00	0.00	0.00

Notes: Panel C reports enrollment choice probabilities just below ($Z=0$) and just above ($Z=1$) the admission threshold, as predicted by the estimated RD model. Bold entries in Panel C are ones in which compliers are present. All compliers enroll immediately in Norway when $Z=1$, but differ in their alternative choices when $Z=0$.

old. Our analytic sample consists of 1,680 applicants who fall no more than 5 points below the threshold, and 1,196 applicants who lie no more than 5 points above it.

Choice patterns by application score. Panel B of Table 1 shows how average enrollment decisions made by applicants evolve across the distribution of application score relative to admission thresholds for domestic medical school. Strikingly, only 32 percent of applicants within 5 points below the admission threshold (and 18 percent more than 5 points below it) fully cooperate with the assignment scheme by immediately enrolling in a Norwegian study program.

Among the remaining applicants in the 5-point neighborhood below the threshold who "defect", 20 percent complete a medical degree abroad, mostly with no delay in enrollment. The rest do so by enrolling in medical school after a delay of more than one year (19 percent) or by enrolling in a non-medical study program but continuing to apply unsuccessfully more than one year later (26 percent).[15] While the latter set of applicants often take up a non-medical degree without a substantial delay in enrollment, they may engage in costly efforts to improve their odds of admission, such as re-attempting high school grades, which we cannot observe.

Among applicants more than 5 points below the admission threshold, defection occurs most commonly through enrollment in medicine in Eastern Europe with or without a delay (29 percent of applicants), and through pursuit of a domestic non-medical degree after failing for several years to secure enrollment in medical school (34 percent). However, 11 percent of these applicants still manage to secure a spot in Norwegian medical school after a delay. Very few of these applicants enroll in foreign medical schools outside Eastern Europe.

Choice patterns at the margin of admissions. Finally in Panel C we report average enrollment choices marginally below ($Z = 0$) or marginally above ($Z = 1$) the admission threshold, coming from estimating the reduced-form of our IV system (Equation 2) on our analytic sample. These are the key inputs necessary for estimating the causal effect of the admission threshold on enrollment choices. The always-takers (who immediately enroll in Norwegian medical school even with $Z = 0$) constitute 30 percent of the sample, while never-takers (who do not immediately enroll in Norwegian medical school even with $Z = 1$) correspond to 12 percent. The bold cells in the table's first two columns emphasize where compliers reside:

[15] The 26 percent comes from "delayers" in a non-medical program in Norway–also includes a small number of students who delay their enrollment in a non-medical program by more than one year, regardless of their later application choices.

in immediate enrollment in Norway above the admission threshold (where they are mixed in with always-takers), and in all other choice alternatives below it (where they are mixed in with never-takers). The "DIFF" column reveals the share of marginal applicants who are compliers (in the first row) and how compliers are distributed by their preferred enrollment alternative when rejected from Norwegian medical schools (the remaining rows). Compliers make up 58 percent of marginal applicants. Of the compliers, 39 percent would immediately enroll in a different program if rejected, and 19 percent specifically in a medical program abroad. Among the compliers who go abroad if rejected, the majority study medicine in Denmark. This contrasts with applicants further away from the admission threshold, among whom Eastern Europe is a more common medical school destination.

Applicant characteristics and outcomes by score and enrollment choice. To provide a clearer sense for the raw data to which group-specific effect bounds will be fit, it is useful to see how applicants and their outcomes evolve across the score distribution–and how this is related to their choices. We present this information for key medical school enrollees across segments of the application score in Table 2. The three score-distance columns are selected from the full characterization across the choice and application score distribution reported in Tables A1 (for covariates) and A2 (for outcomes); the $Z = 0$ and $Z = 1$ columns instead report expectations for compliers at the admission threshold, under rejection and admission respectively.

Medical school enrollees who come from the lower end of the applicant score distribution (more than 5 points below the admission threshold) go primarily to Eastern European schools, as already established in Panel B of Table 1. Compared to compliers at the threshold–who primarily go to Denmark if rejected and not delaying for a domestic admission–these lower-scoring students come disproportionately from immigrant backgrounds (40 percent) and are less likely to have parent with a college degree (71 percent).

Basic outcomes for these medical school enrollees are remarkably similar across enrollment destinations and the applicant score distribution: most students successfully graduate medicine, receive authorization to practice, and are living and working in Norway within 10 years of their initial application. This generalization, though, has one stark exception: while the compliers who enroll in Danish medical school when rejected almost all complete their studies, only 65 percent of them receive authorization to practice in Norway and fewer than half of them return to live and work in Norway.

Table 2. Key medical school destinations and outcomes of their enrollees across the score distribution

	Score distance			Compliers at threshold	
	<-5	[-5, -0.2]	[0.2, 5]	$Z = 0$	$Z = 1$
Key destination	East. Eur.	East. Eur.	Norway	Denmark	Norway
Share of applicants	0.23	0.10	0.92	0.08	0.88
Share incl. delayers	0.29	0.13	0.95	0.11	0.93
Average characteristics of key destination enrollees:					
Age at application	19.60	19.38	19.60	19.33	20.03
Female	0.63	0.67	0.62	0.66	0.60
Immigrant	0.40	0.30	0.21	0.20	0.18
Parent with HE	0.71	0.80	0.86	0.92	0.85
Parent with med degree	0.11	0.14	0.18	0.11	0.17
Rural Background	0.21	0.20	0.27	0.27	0.20
Expected outcomes for key destination enrollees:					
MD graduate	0.85	0.91	0.92	0.98	0.90
Med. Authorization	0.89	0.92	0.92	0.65	0.90
Employed	0.90	0.96	0.96	0.46	0.97
Living in Norway	0.94	0.99	0.98	0.48	0.99

Notes: "Key destination" is the most common medicine-abroad choice among immediate enrollers at the given position in the score distribution, per panels B and C of Table 1; for the $Z = 1$ column we report Norwegian medical school. "Share of applicants" and "share incl. delayers" report the share of applicants choosing the key destination immediately, and immediately or after a delay, respectively. The three score-distance columns average over all immediate enrollers in the key destination, with characteristics drawn from Appendix Table A1 and outcomes from Appendix Table A2. The $Z = 0$ and $Z = 1$ columns instead report expectations for *compliers* at the admission threshold: $Z = 1$ gives treated compliers, who enroll immediately in Norwegian medical school, and $Z = 0$ gives untreated compliers whose alternative is immediate enrollment in Denmark. These are the same complier expectations that underlie Table 3.

Complier Characteristics. Table 3 next reports estimates of average characteristics for complier subgroups, inferred from comparing model-implied expected outcomes (reported in Table A3) and enrollment choices (Panel C of Table 1) above versus below the admission threshold. Compared to an average complier, a Denmark-switcher (who enrolls in medical schools in Denmark if rejected), is younger, more likely to be male, less likely to be an immigrant, more likely to have parents with higher education. Delayers are less likely to come from rural areas.

Table 3. Pre-determined characteristics of complier subgroups

		By enrollment choice if rejected						
		Immediate-enrollers			Delayers			
		Medicine			Medicine			
Covariate	Mean	DK	Other	Other	NO	DK	Other	Other
Age at application	19.59	19.33	18.92	19.61	20.12	19.06	18.64	19.29
Female	0.71	0.66	0.78	0.74	0.73	0.84	0.63	0.59
Immigrant	0.26	0.20	0.12	0.36	0.31	0.12	-0.03	0.24
Parent with HE	0.80	0.92	0.96	0.80	0.83	0.75	0.70	0.60
Parent with med degree	0.12	0.11	0.19	0.11	0.14	0.13	-0.28	0.11
Rural Background	0.21	0.27	0.19	0.29	0.18	0.18	0.32	0.10

Notes: Each cell reports estimated mean pre-determined characteristics for a complier subgroup, inferred from contrasting model-implied expectations above versus below the admission threshold. The Mean column averages across all untreated complier subgroups. Immediate enrollers opt into their alternative within one year of applying; Delayers wait at least one year.

6.3 Main findings

In this section, we present our main findings on effects for complier subpopulations. For alternative complier subpopulations and outcomes, figures 10-12 visualize the ingredients that enter the calculation of bounds on subpopulation-specific effects. In each figure, the first estimate (the solid dot on the left) corresponds to the mean treated outcome for all compliers. This point estimate would be consistent for the average treated outcome for *any* complier subpopulation if applicants selected randomly into their next-best enrollment choice.

The dashed line represents the estimate for the average untreated potential outcome for a given complier subpopulation of interest: all always-enrollers (Figure 10) or Denmark-switchers (Figures 11 and 12). The hollow points are bounds on the average treated outcome

for that same complier subpopulation, and the shaded areas are 95 percent confidence intervals drawn around those bounds. The "worst-case" bounds correspond exactly to bound estimates described in Section 6.1. The remaining three sets of bound estimates leverage more data and assumptions to tighten these bounds:

1. **IV assumption**: we indirectly *enforce* the IV assumptions through "sign-screening" of the first stage and that, for binary outcomes, IV estimates are not larger than 1 in magnitude (which would require the instrument to affect non-compliers).[16]

2. **Covariate groups**: we partition the data into three covariate groups, estimate bounds separately within each group, and average up the bounds as described by Lee [2009].[17]

3. **Monotone Treatment Response (MTR) assumption**: we assume one's outcomes weakly improve when one studies medicine in Norway.

Effects on all always-enrollers. For the full "always-enroller" subpopulation of compliers, we find that immediately enrolling in medical school in Norway increases the likelihood that one is residing in Norway 10 years later (panel a of Figure 10); our 95% confidence interval on the tightest bounds suggest always-enrollers are 3 percentage points to 24 percentage points more likely to live in Norway if they study medicine there. We find it increases their employment in Norway by a similar amount (panel b of Figure 10), with a 95% confidence interval on the tightest bound running from a 3 to 26 percentage point increase in employment. For estimating employment effects, the MTR assumption meaningfully tightens bounds. Bounds for the effect on living in Norway, by contrast, are tight even with pure worst-case bounds because it is so rare for individuals who studied medicine in Norway to leave the country.

Effects on Denmark-switchers. When we narrow in on the Denmark-switcher subpopulation–the key complier subgroup among those who study medicine abroad when rejected–panel a of Figure 11 shows that only 49 percent of these compliers return to Norway within 10 years if rejected from domestic medical school and induced to study medicine in Denmark. Our

[16] Angrist and Kolesár [2024] show that screening on the sign of the estimated first stage can reduce bias of the IV estimator without affecting coverage.

[17] We construct covariate groups by first regressing earnings *among domestically-trained doctors* on sex, age, parental income rank, whether one's parent has a medical degree, immigration status, and whether one was raised in an urban or rural community. We then predict one's earnings as a domestically-trained doctor based on those covariates, and group individuals into three groups based on their tertile in the predicted earnings distribution.

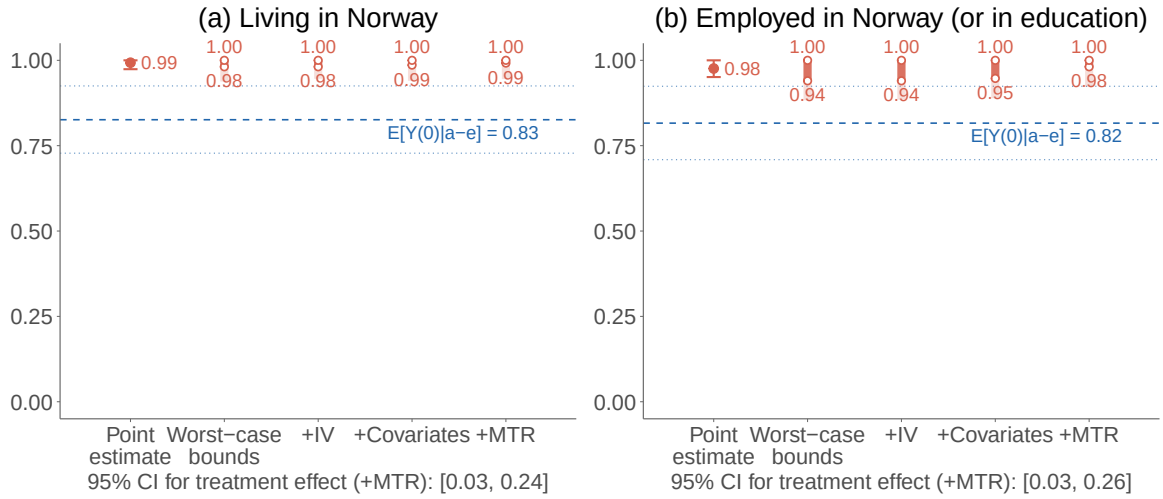
bounds on the average effect on living in Norway are informative: our tightest 95 percent confidence interval suggests that studying medicine domestically instead of Denmark increases their probability of living in Norway 10 years later by between 19 and 79 percentage points. Estimates in Figure 11 suggest even larger effects on employment in Norway for this group (23 to 83 percentage points).

6.4 Will effects of studying medicine domestically persist over time?

The extent to which Denmark-switchers remain abroad if rejected from domestic medical schools is striking. Do these effects reflect a change in one's intent or one's ability to work in Norway in the long-term? These outcomes being observed 10 years post-application gives students some time to have settled themselves and established their careers. With returning to Norway becoming no easier or more attractive as these students' careers progress, it is reasonable to think that these effects will continue to persist over time.

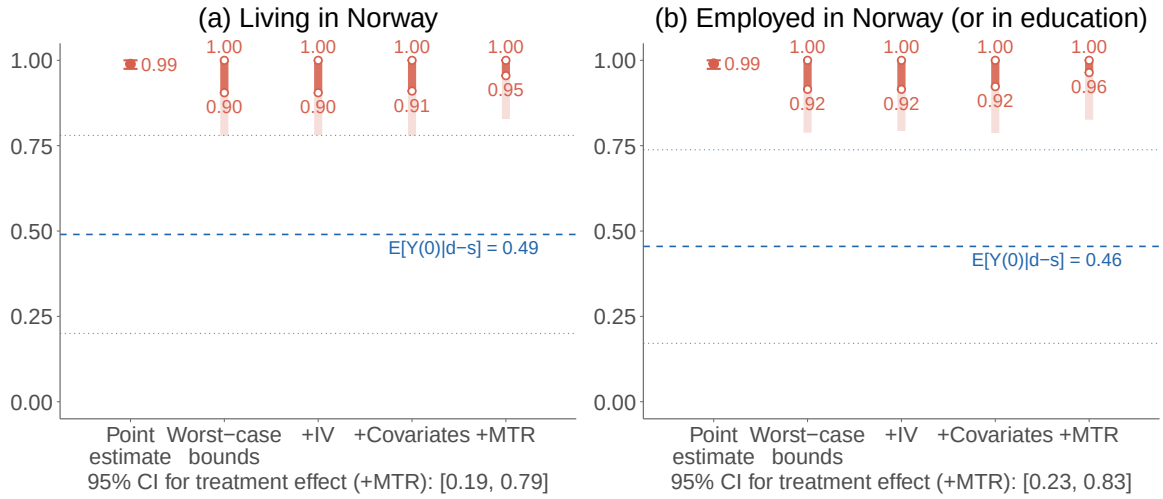
But to gauge this, we examine effects on an intermediary outcome: authorization to practice medicine in Norway. This is a relatively straightforward bureaucratic process that a doctor with a medical license from Denmark must undergo if he or she intends to practice medicine in Norway. Figure 12 shows that only 66 percent of Denmark-switchers are receiving this authorization if they study medicine in Denmark. Meanwhile, virtually all compliers as a whole are authorized if they study medicine domestically. Confidence intervals on our bounds suggest studying in Norway instead increases medical authorization rates by at least 19 percentage points. In other words, many students who study abroad in Denmark are not returning to Norway for work 10 years later–and they appear to be making no meaningful attempt to do so.

Figure 10. All always-enrollers: residential and employment effects of enrolling in medicine in Norway



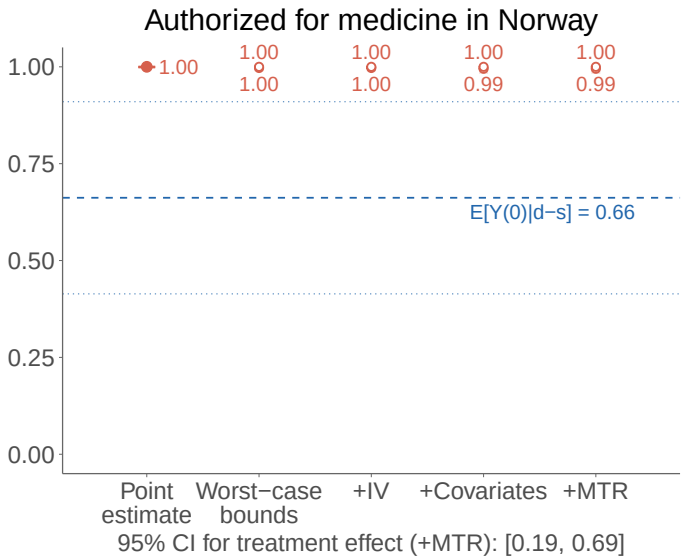
Note: The dashed line denotes expected untreated potential outcomes among always-enrollers (abbreviated 'a-e'). All estimates in red are for treated expectations among always-enrollers. The point estimate assumes random selection into always-enrollment. The confidence intervals for bounds are corrected for finite sample bias following [Imbens and Manski, 2004, eq. 6-7]. See Section 6.1 for estimation methods.

Figure 11. Denmark-switchers: residential and employment effects of enrolling in medicine in Norway



Note: The dashed line denotes expected untreated potential outcomes among Denmark-switchers (abbreviated 'd-s'). All estimates in red are for treated expectations among Denmark-switchers. The point estimate assumes random selection into being a Denmark-switcher. The confidence intervals for bounds are corrected for finite sample bias following [Imbens and Manski, 2004, eq. 6-7]. See Section 6.1 for estimation methods.

Figure 12. Denmark-switchers: medical authorization effects of enrolling in medicine in Norway



Note: The dashed line denotes expected untreated potential outcomes among Denmark-switchers (abbreviated 'd-s'). All estimates in red are for treated expectations among Denmark-switchers. The point estimate assumes random selection into being a Denmark-switcher. The confidence intervals for bounds are corrected for finite sample bias following [Imbens and Manski, 2004, eq. 6-7]. See Section 6.1 for estimation methods.

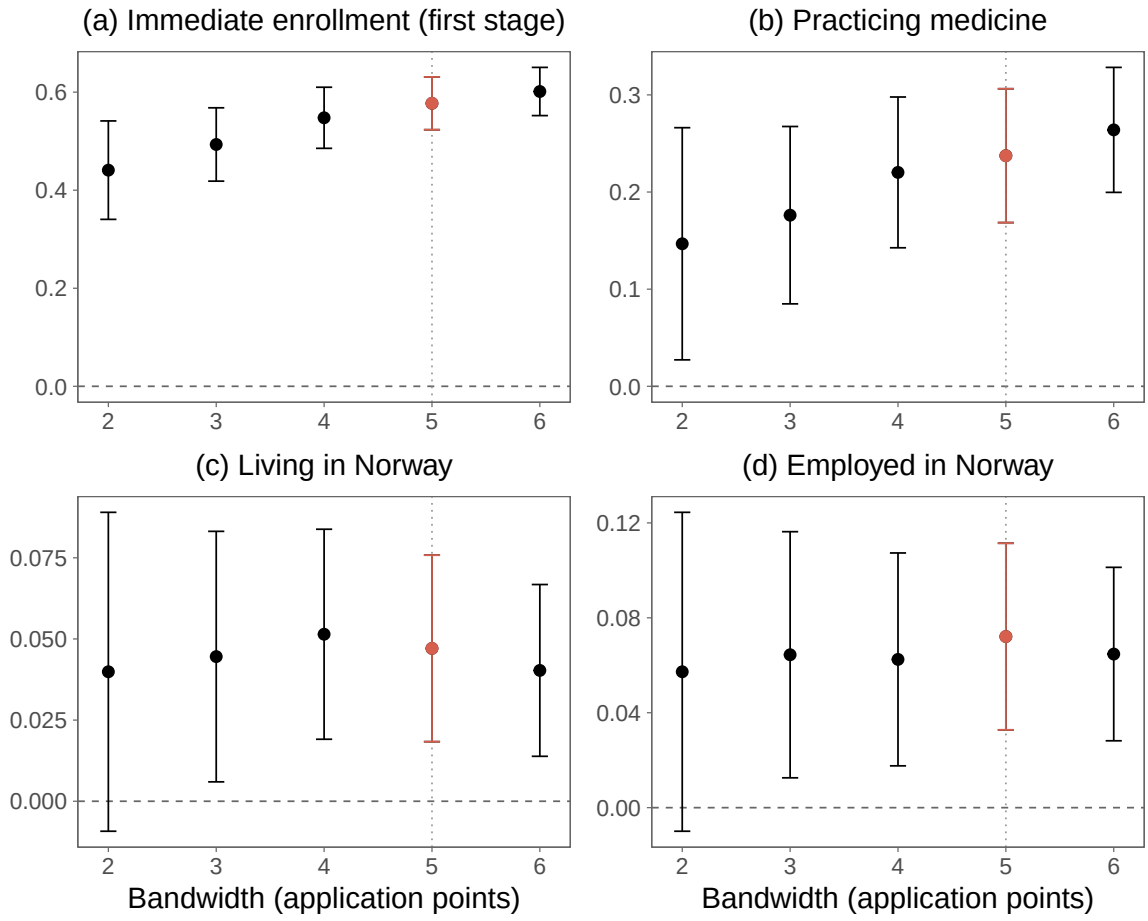
7 Sensitivity analysis

In this section we investigate the sensitivity of our results to the choice of window size and "donut" size.

7.1 Sensitivity to window size choice

Figure 13 shows our estimates for window sizes ranging from 2 to 6 application points. As expected, estimates based on narrower windows are less precise; widening the window reduces variance but may increase bias [Cattaneo et al., 2019, p. 107]. Nonetheless, the point estimates remain stable across this range. Estimates from the baseline specification are shown in red. Every confidence interval overlaps our baseline estimate at a 5-point window, and the effects on living and working in Norway remain positive and distinguishable from zero at every window size we consider. The first stage and the effect on practicing medicine drift up modestly as the window widens, but none of our conclusions turn on where we cut the window.

Figure 13. Sensitivity of year-10 ITT estimates to choice of regression discontinuity bandwidth



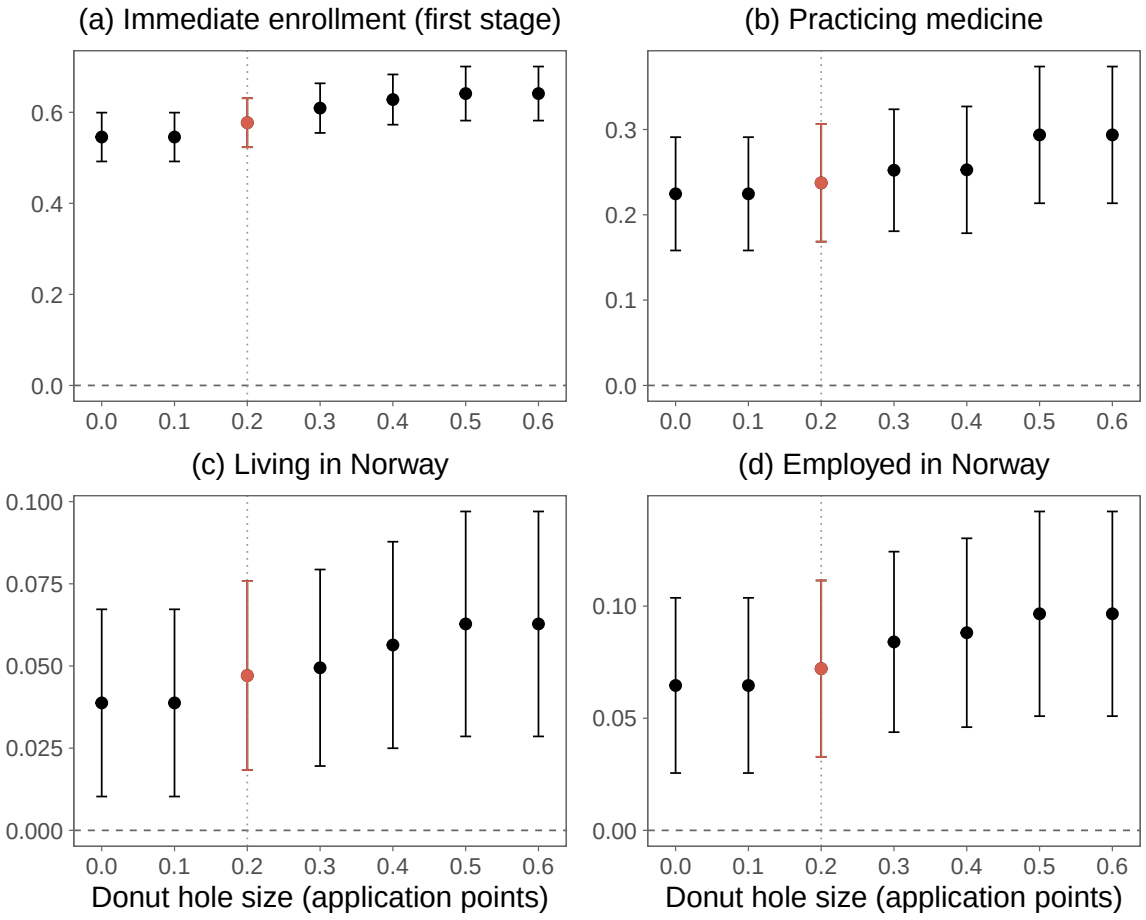
Note: Each panel reports the ITT estimate for the given outcome as we vary the regression discontinuity bandwidth, keeping the specification of the design otherwise fixed as described in Section 4.1. Our baseline specification, marked in red, uses a bandwidth of 5 points. Effects are estimated 10 years post-application.

7.2 Sensitivity to observations near the admission threshold

By implementing a "donut hole" approach we test the sensitivity of the results to the impact of observations closest to the admission threshold [Cattaneo et al., 2019]. This approach involves excluding units very close to the threshold and repeating the estimation with the remaining sample. In Figure 14 we check the sensitivity of our estimates to excluding observations within a two-sided donut hole of varying radius, from 0 to 0.6 application points. Point estimates rise slightly as the donut widens, but every confidence interval overlaps our

baseline estimate at a 0.2-point donut, and the effects on living and working in Norway again remain positive and distinguishable from zero throughout. Units closest to the admission threshold therefore do not drive our results.

Figure 14. Sensitivity of year-10 ITT estimates to choice of regression discontinuity donut



Note: Each panel reports the ITT estimate for the given outcome as we vary the width of the two-sided donut used in our regression discontinuity design, keeping the specification of the design otherwise fixed as described in Section 4.1. Our baseline specification, marked in red, uses a donut of 0.2 points. Effects are estimated 10 years post-application.

Taken together, Figures 13 and 14 indicate that neither the choice of window size nor the choice of donut radius materially affects our conclusions.

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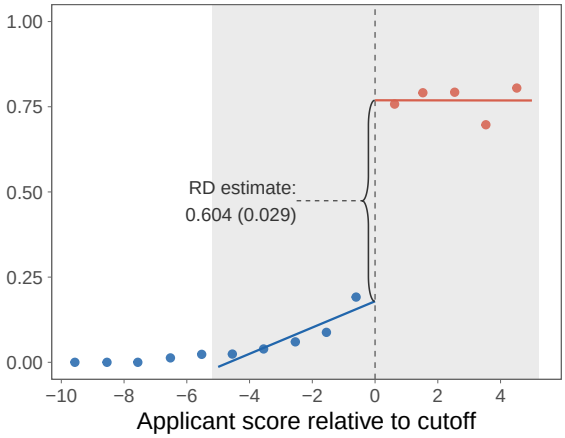
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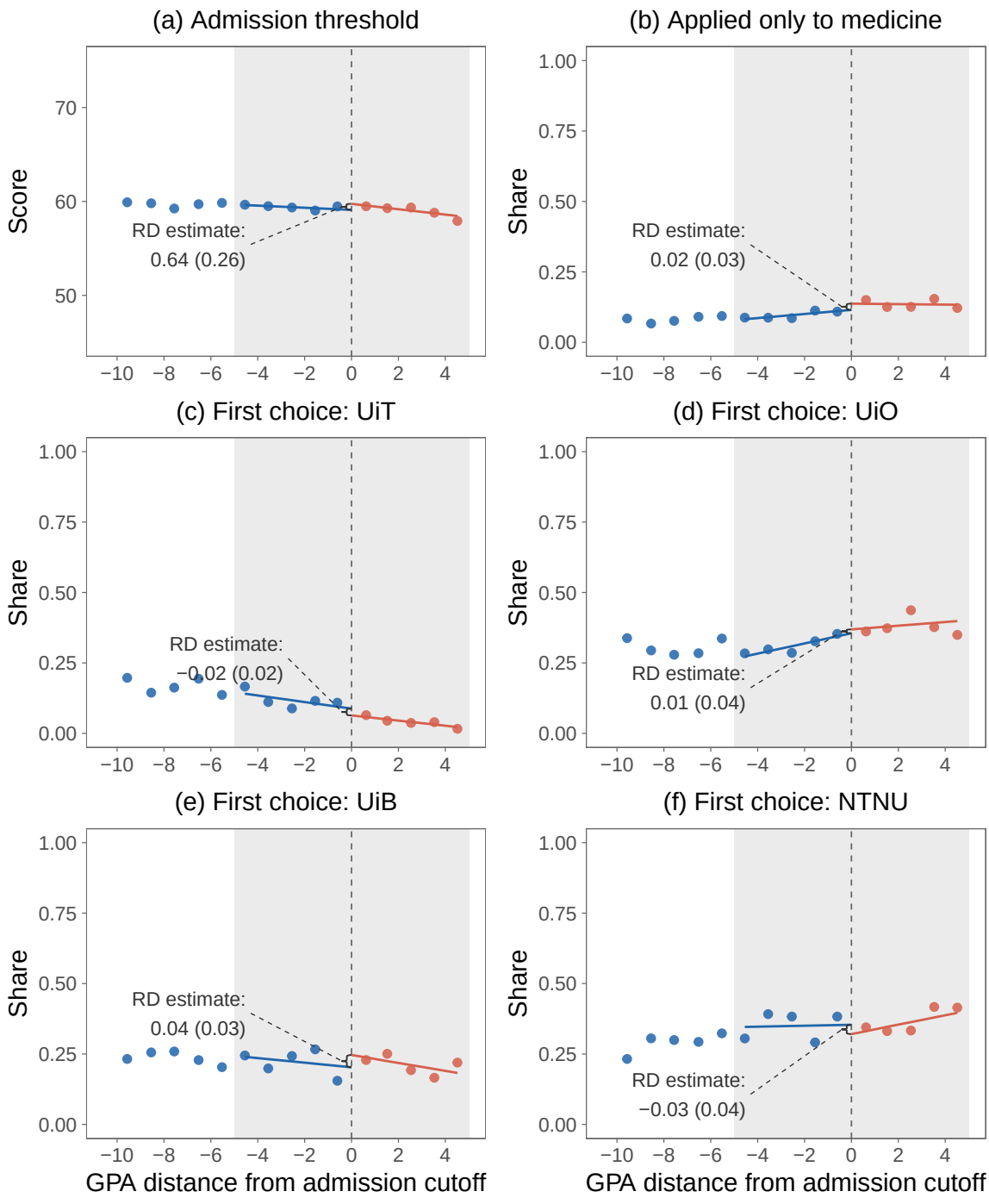
A Appendix

Figure A1. The effect of the admission threshold crossing on getting an offer *and* enrolling in medical studies in Norway



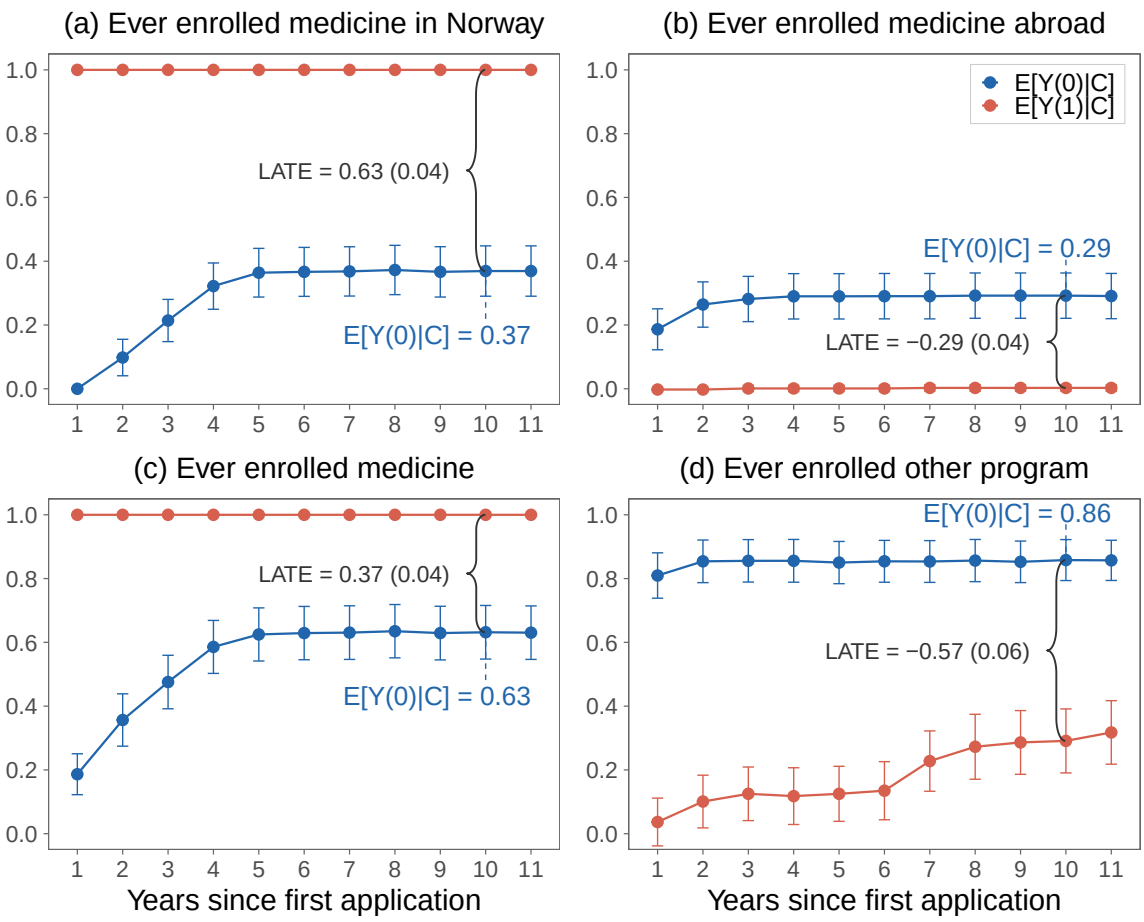
Notes: Across the five enrollment cohorts covering 2007-2012, applicants eligible for a special quota could have been admitted with application points 5.2, 3.9, 3.6, 2.3, and 4.2 points below the designated threshold respectively. The gray region indicates scores that could have led to a special quota admission in the most lenient year–5.2 points below the threshold. The estimates are based on the local linear RD estimator with a uniform kernel function and a bandwidth of 5 application points.

Figure A2. Balance in application characteristics around the admission threshold



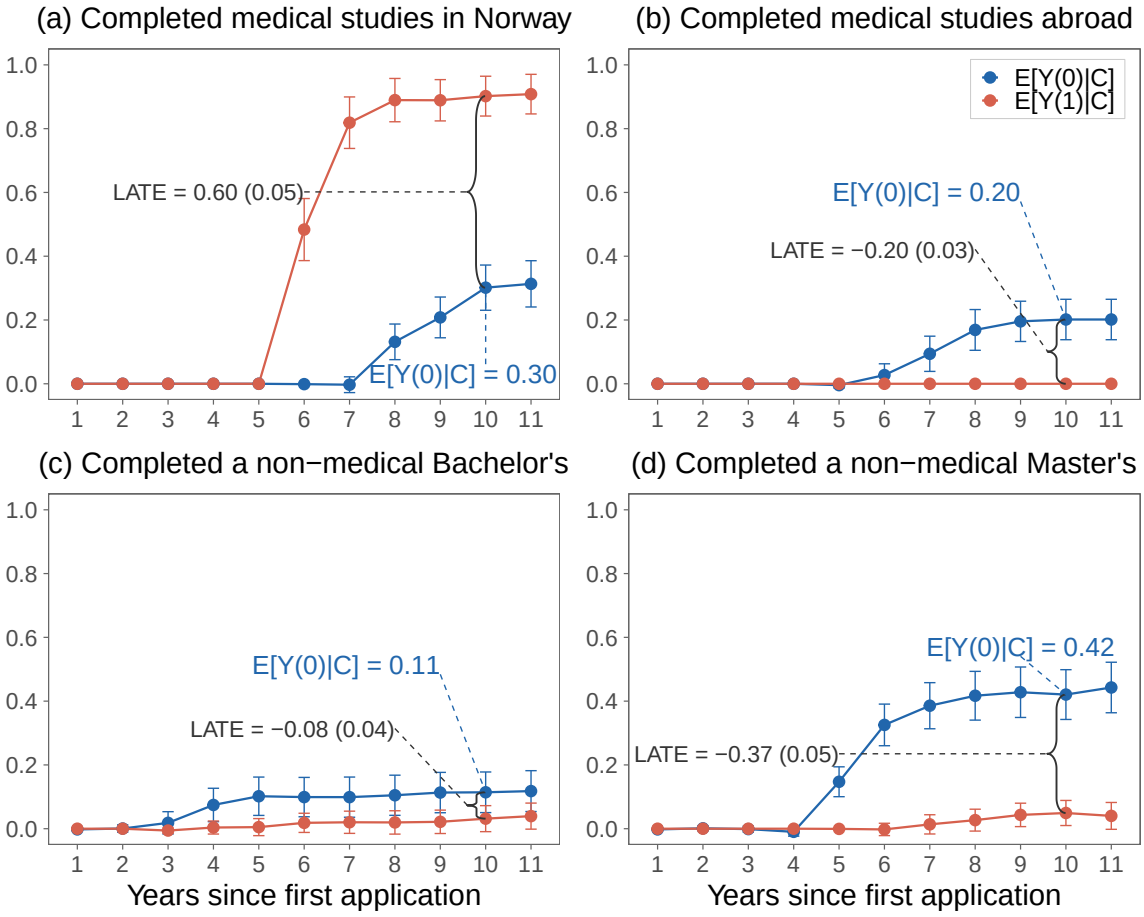
Note: Each graph shows local values of covariates on both sides of the cutoff point. All covariates are created based on application data. Plot (a) shows a mean value of admission threshold before it was normalized to zero. Plot (b) depicts a share of applicants who included only medicine into their application and no other educational fields. Plots (c)-(f) show a share of applicants who had a specific medical university as their first choice in application. The estimates are based on the local linear RD estimator with a uniform kernel function and a bandwidth of 5 application points.

Figure A3. Educational outcomes (enrollment) for compliers



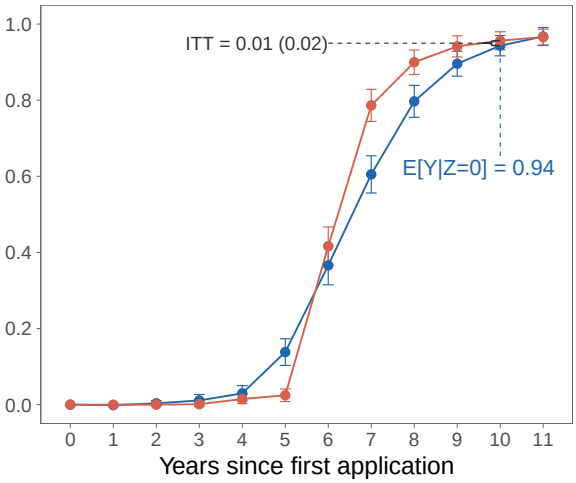
Note: LATE counterpart to Figure 5. Each panel graphs expected enrollment outcomes for treated compliers ($E[Y(1)|C]$) and untreated compliers ($E[Y(0)|C]$) by year since the initial application. Complier expectations are calculated using Abadie's method [Abadie, 2002]. The confidence intervals are at the 95% confidence level.

Figure A4. Degree completion for compliers



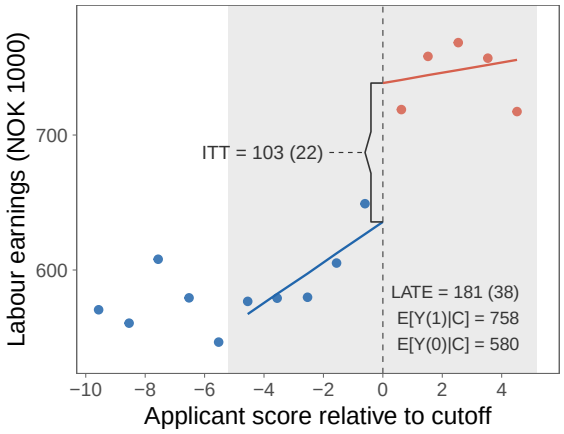
Note: LATE counterpart to Figure 6. Each panel graphs expected completion outcomes for treated compliers ($E[Y(1)|C]$) and untreated compliers ($E[Y(0)|C]$) by year since the initial application. Complier expectations are calculated using Abadie's method [Abadie, 2002]. The confidence intervals are at the 95% confidence level.

Figure A5. Effect of threshold crossing on completion of any degree



Note: The confidence intervals are calculated using bootstrap and are at the 95% confidence level.

Figure A6. The effect of threshold crossing on earnings 10 years later



Note: The parameters for compliers are calculated using Abadie's method [Abadie, 2002].

Table A1. Average characteristics by application score distance to the admission threshold

	Among immediate enrollers in:					Among delayers in:				
	Medicine					Medicine				
Study Destination:	NO	DK	E. Eur.	Other	Other	NO	DK	E. Eur.	Other	Other
Score band: < -5										
Age at application	21.63	19.88	19.60	19.61	19.77	20.03	19.17	19.40	–	19.73
Female	0.61	0.62	0.63	0.62	0.68	0.70	0.70	0.67	–	0.61
Immigrant	0.13	0.23	0.40	0.62	0.33	0.17	0.22	0.26	–	0.31
Parent with HE	0.79	0.85	0.71	0.73	0.62	0.81	0.87	0.77	–	0.68
Parent with med degree	0.16	0.12	0.11	0.15	0.08	0.21	0.35	0.12	–	0.11
Rural Background	0.42	0.18	0.21	0.27	0.29	0.35	0.04	0.28	–	0.32
Score band: $[-5, -0.2]$										
Age at application	20.04	19.41	19.38	19.25	19.49	19.89	19.06	19.23	19.14	19.36
Female	0.72	0.69	0.67	0.75	0.71	0.70	0.69	0.62	0.57	0.65
Immigrant	0.15	0.21	0.30	0.42	0.22	0.23	0.14	0.21	0.00	0.24
Parent with HE	0.79	0.89	0.80	0.96	0.78	0.85	0.83	0.81	0.86	0.79
Parent with med degree	0.13	0.13	0.14	0.17	0.08	0.15	0.26	0.25	0.14	0.11
Rural Background	0.42	0.22	0.20	0.12	0.29	0.26	0.17	0.25	0.14	0.25
Score band: $[0.2, 5]$										
Age at application	19.60	19.39	–	–	19.53	19.05	–	–	–	19.88
Female	0.62	0.92	–	–	0.53	0.65	–	–	–	0.80
Immigrant	0.21	0.08	–	–	0.10	0.08	–	–	–	0.16
Parent with HE	0.86	0.92	–	–	0.89	0.90	–	–	–	0.92
Parent with med degree	0.18	0.31	–	–	0.16	0.30	–	–	–	0.24
Rural Background	0.27	0.15	–	–	0.42	0.28	–	–	–	0.28

Notes: Columns indicate the applicant's actual enrollment choice. Immediate enrollers enrolled within one year of applying; Delayers enrolled after more than one year. Cells based on fewer than 10 individuals are suppressed.

Table A2. Mean outcomes by application score distance to the admission threshold

	Among immediate enrollers in:					Among delayers in:				
	Medicine					Medicine				
Study Destination:	NO	DK	E. Eur.	Other	Other	NO	DK	E. Eur.	Other	Other
Score band: < -5										
MD graduate	0.84	0.79	0.82	0.85	0.00	0.23	0.56	0.49	–	0.00
Med. Authorization	0.84	0.44	0.73	0.77	0.00	0.23	0.09	0.50	–	0.00
Employed	0.95	0.76	0.87	0.69	0.92	0.72	0.26	0.76	–	0.82
Living in Norway	0.97	0.76	0.91	0.81	0.96	0.99	0.35	0.72	–	0.97
Score band: $[-5, -0.2]$										
MD graduate	0.86	0.83	0.89	0.75	0.00	0.29	0.34	0.73	0.29	0.00
Med. Authorization	0.86	0.27	0.76	0.79	0.00	0.28	0.00	0.56	0.00	0.00
Employed	0.95	0.44	0.91	0.79	0.91	0.73	0.17	0.79	0.29	0.82
Living in Norway	0.99	0.52	0.96	0.88	0.96	0.99	0.26	0.87	0.71	0.97
Score band: $[0.2, 5]$										
MD graduate	0.89	0.92	–	–	0.00	0.62	–	–	–	0.00
Med. Authorization	0.89	0.23	–	–	0.05	0.62	–	–	–	0.00
Employed	0.94	0.31	–	–	0.95	0.73	–	–	–	0.72
Living in Norway	0.98	0.31	–	–	1.00	1.00	–	–	–	0.92

Notes: Columns indicate the applicant's actual enrollment choice. Immediate enrollers enrolled within one year of applying; Delayers enrolled after more than one year. Outcomes are measured 10 years after application. Cells based on fewer than 10 individuals are suppressed.

Table A3. Average characteristics at the admission margin

	Age		Female		Immigrant		Parent Education: College		Parent Education: Medicine		Rural	
	$Z=0$	$Z=1$	$Z=0$	$Z=1$	$Z=0$	$Z=1$	$Z=0$	$Z=1$	$Z=0$	$Z=1$	$Z=0$	$Z=1$
Among immediate enrollers in:												
Med in Norway	19.58	**19.88**	0.74	**0.65**	0.18	**0.18**	0.81	**0.84**	0.11	**0.15**	0.41	**0.27**
Med in Denmark	**19.30**	19.00	**0.75**	1.06	**0.17**	0.06	**0.91**	0.82	**0.08**	-0.06	**0.27**	0.29
Med, Other Abroad	**19.08**	23.50	**0.77**	0.75	**0.17**	0.75	**0.96**	1.00	**0.19**	0.25	**0.17**	0.00
Other	**19.60**	19.57	**0.70**	0.43	**0.32**	0.14	**0.82**	0.95	**0.12**	0.14	**0.31**	0.38
Among delayers in:												
Med in Norway	19.90	**18.84**	0.73	**0.73**	0.27	**0.12**	0.84	**0.88**	0.17	**0.27**	0.21	**0.35**
Med in Denmark	**19.28**	–	**0.86**	–	**0.11**	–	**0.75**	–	**0.14**	–	**0.19**	–
Med, Other Abroad	**18.78**	–	**0.61**	–	**-0.06**	–	**0.72**	–	**-0.28**	–	**0.33**	–
Other	**19.02**	16.29	**0.65**	0.77	**0.23**	0.17	**0.70**	0.91	**0.15**	0.23	**0.17**	0.34

Notes: Each cell reports the estimated conditional mean of a pre-determined characteristic for applicants in a given enrollment group, estimated just below ($Z = 0$) or just above ($Z = 1$) the admission threshold. Immediate enrollers enrolled within one year of applying; Delayers after more than one year. Suppressed cells correspond to groups with zero estimated probability at the threshold. Bold entries are ones in which compliers are present.

Table A4. Expected outcomes at the admission margin

	MD graduate		Authorization		Employed		Living in Norway	
	$Z=0$	$Z=1$	$Z=0$	$Z=1$	$Z=0$	$Z=1$	$Z=0$	$Z=1$
Among immediate enrollers in:								
Med in Norway	0.83	**0.87**	0.83	**0.87**	0.93	**0.93**	0.99	**0.99**
Med in Denmark	**0.94**	0.82	**0.19**	-0.06	**0.31**	0.29	**0.32**	0.29
Med, Other Abroad	**0.73**	0.75	**0.85**	1.00	**0.79**	0.75	**0.94**	1.00
Other	**0.00**	0.00	**0.01**	0.05	**0.91**	1.05	**0.97**	1.00
Among delayers in:								
Med in Norway	0.40	**0.71**	0.40	**0.71**	0.79	**0.82**	1.00	**1.00**
Med in Denmark	**0.19**	–	**0.00**	–	**0.08**	–	**0.19**	–
Med, Other Abroad	**0.39**	–	**0.33**	–	**0.44**	–	**0.83**	–
Other	**0.00**	0.00	**0.00**	0.00	**0.85**	0.71	**0.95**	0.86

Notes: Each cell reports the estimated conditional mean of an outcome for applicants in a given enrollment group, estimated just below ($Z=0$) or just above ($Z=1$) the admission threshold. Outcomes are measured 10 years after application. Immediate enrollers enrolled within one year of applying; Delayers after more than one year. Suppressed cells correspond to groups with zero estimated probability at the threshold. Bold entries are ones in which compliers are present.

B Educational Strategies and Transfers

In this section, we investigate to what extent individuals near the admission threshold transfer into medicine from fields such as dentistry and nutrition, transfer between medical schools in Norway, transfer between medical schools in different countries, or start their medical education at a private college in Norway and continue abroad.

Most pronounced differences are presented in Figure B7. Plot (a) shows to what extent individuals studied dentistry or nutrition before enrolling in medicine. The first year of medicine, dentistry, and nutrition covers the same disciplines. One can get these disciplines approved once admitted to medical school or even get a spot right in the second year[18]. This possibility causes high dropout rates, especially from the nutrition program[19], as students often enroll in this program not as their first choice, but while waiting for admission to medical school. In addition, years in higher education are rewarded with additional application points, which could be beneficial for future higher education applications. For this reason, we consider an applicant to be an "immediate-enroller" in Norwegian medical school if he or she successfully transfers from dentistry or nutrition into medical school after one year.

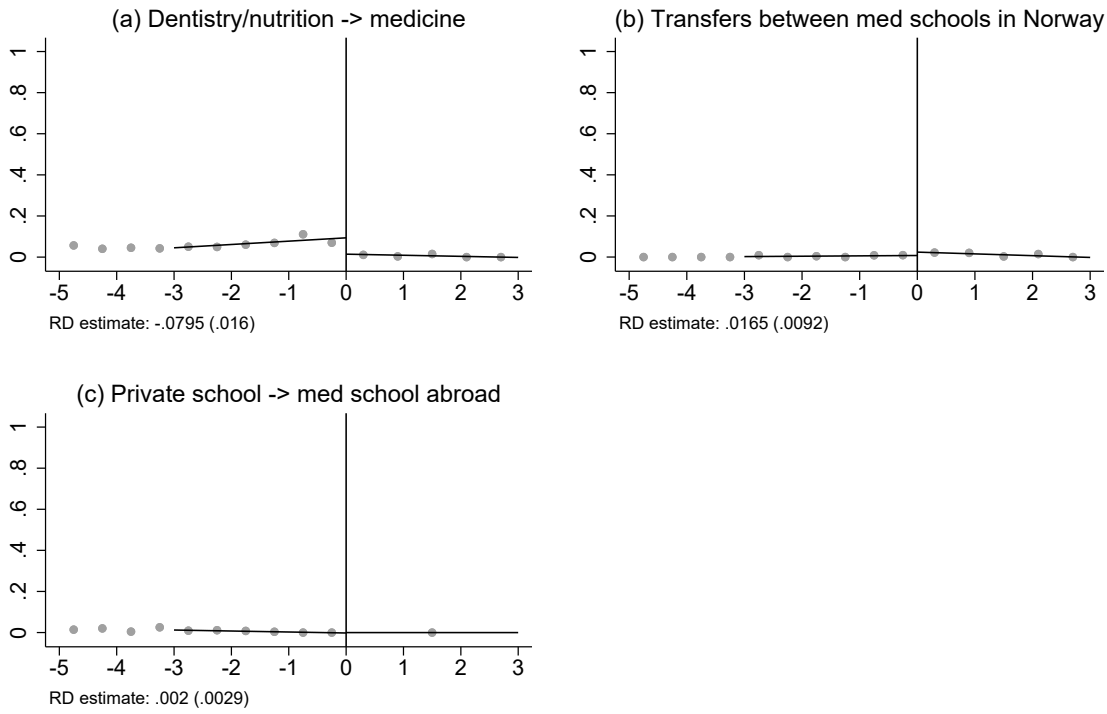
Plot (b) shows to what extent students transfer between medical schools in Norway. The number of such transfers is slightly higher among students above the admission threshold, but still very low.

Private colleges such as Høyskolen Kristiania, Bjørknes høyskole, and Atlantis medisinske høyskole offer basic 1–3 year studies in Norway with further studies at selected medical universities abroad [Grimstadutvalget, 2019]. Plot (c) shows that individuals further away from the threshold tend to start first at private schools before starting their studies abroad, but they are also quite few.

[18] https://www.med.uio.no/studier/om/regelverk/fritak-opprykk-prop.html

[19] https://www.khrono.no/vil-fjerne-snarvei-for-studenter-som-onsker-a-studere-medisin/752749

Figure B7. Educational strategies and program transfers



Note: Each panel plots local means of the outcome against the applicant's score relative to the admission threshold, together with local linear fits on either side. Panel (a) reports the share who enrolled in dentistry or nutrition before enrolling in medicine, panel (b) the share who transferred between Norwegian medical schools, and panel (c) the share who attended a private Norwegian college before beginning medical studies abroad. The RD estimate reported below each panel is the effect of crossing the admission threshold, with its standard error in parentheses.

Transfers from medical schools abroad to medical schools in Norway are exceedingly rare, as are transfers between countries.

C Partially identifying treatment effects for always-enrollers

This section establishes our key partial identification results. As we are exploiting a regression discontinuity design, all our results concern effects for individuals at the margin of admissions to medical school. For brevity, we omit this condition ($R = c$) from all expectations in this section.

Throughout, we use only the assumptions already imposed in Section 3: Exclusion (Assumption 1), Random Assignment (Assumption 2), Monotonicity (Assumption 3), and In-

strument Relevance (Assumption 4).

We partially identify $\lambda_{\text{always-enroller}}$ by *point* identifying the always-enroller untreated expectation and *bounding* the treated expectation:

$$\lambda_{\text{always-enroller}} \equiv \underbrace{E[Y(\mathbf{D}^1)|I(0)=1,\mathbb{C}]}_{\text{bound}} - \underbrace{E[Y(\mathbf{D}^0)|I(0)=1,\mathbb{C}]}_{\text{point identify}}$$

Recall that an applicant's assignment $\mathbf{D} \equiv (M,I)$ collects both the field and location of study M and the timing of enrollment I, and that treatment is $D \equiv \mathbb{1}\{\mathbf{D} = \mathbf{D}^1\}$ with $\mathbf{D}^1 \equiv (M^{\text{D-Med}}, 1)$. Note that this means $D = 1$ implies $I = 1$.

C.1 Identifying untreated marginal distributions for complier subgroups

Our three complier subgroups are defined by the assignment an applicant would take up if rejected, $\mathbf{D}(0)$. The following lemma shows that the expected untreated outcome is identified for any such subgroup, including the always-enrollers.

Lemma 1. *Let $\mathscr{M}$ be any subset of the support of $\mathbf{D}$ other than $\mathbf{D}^1$, let $G \equiv \mathbb{1}\{\mathbf{D} \in \mathscr{M}\}$, and let $G(z) \equiv \mathbb{1}\{\mathbf{D}(z) \in \mathscr{M}\}$ denote its potential values. If Assumptions 1–4 hold and $P(G(0) = 1,\mathbb{C}) > 0$, then*

$$E[Y(\mathbf{D}^0) \mid G(0)=1,\mathbb{C}] = \frac{E[Y(1-D)G \mid Z=0] - E[Y(1-D)G \mid Z=1]}{E[(1-D)G \mid Z=0] - E[(1-D)G \mid Z=1]}. \tag{4}$$

Proof. Consider first the $Z = 1$ term in the numerator. Under $Z = 1$, always-takers and compliers both have $D = 1$, so $(1-D) = 1$ selects never-takers alone. Hence

$$\begin{aligned} E[Y(1-D)G \mid Z=1] =& E[Y(\mathbf{D}^0) \mid \mathbb{N}, G(1)=1, Z=1]\, P(\mathbb{N}, G(1)=1 \mid Z=1) \\ =& E[Y(\mathbf{D}^0) \mid \mathbb{N}, G(1)=1]\, P(\mathbb{N}, G(1)=1) \\ =& E[Y(\mathbf{D}^0) \mid \mathbb{N}, G(0)=1]\, P(\mathbb{N}, G(0)=1), \end{aligned}$$

where the second equality uses Random Assignment (Assumption 2) to drop Z from the conditioning sets, and the third uses $G(1) = G(0)$ for never-takers, which holds because $\mathbf{D}(1) = \mathbf{D}(0)$ for this group.

Under $Z = 0$, by contrast, only always-takers have $D = 1$, so $(1-D) = 1$ selects never-

takers *and* compliers. Because these two groups are disjoint, we can write:

$$\begin{aligned}E[Y(1-D)G \mid Z=0] =& E[Y(\mathbf{D}^0) \mid \mathbb{N}, G(0)=1, Z=0]\, P(\mathbb{N}, G(0)=1 \mid Z=0) \\ &+ E[Y(\mathbf{D}^0) \mid \mathbb{C}, G(0)=1, Z=0]\, P(\mathbb{C}, G(0)=1 \mid Z=0) \\ =& E[Y(\mathbf{D}^0) \mid \mathbb{N}, G(0)=1]\, P(\mathbb{N}, G(0)=1) \\ &+ E[Y(\mathbf{D}^0) \mid \mathbb{C}, G(0)=1]\, P(\mathbb{C}, G(0)=1),\end{aligned}$$

again using Random Assignment to drop Z. Differencing the two expectations, the never-taker terms cancel and the numerator of Equation 4 equals

$$E[Y(\mathbf{D}^0) \mid \mathbb{C}, G(0)=1]\, P(\mathbb{C}, G(0)=1).$$

Repeating the same two steps with Y omitted gives the denominator:

$$E[(1-D)G \mid Z=0] - E[(1-D)G \mid Z=1] = P(\mathbb{C}, G(0)=1), \tag{5}$$

and taking the ratio delivers the result. □

Note that the estimand on the right-hand side of Equation 4 amounts to an implementation of the regression discontinuity design that uses $Y(1-D)G$ as the outcome and $(1-D)G$ as the treatment.

C.2 Bounding expected treated outcomes of always-enrollers

Now to partially identify $\lambda_{\text{always-enroller}}$, what remains is to bound the treated expectation:

$$E[Y(\mathbf{D}^1) | I(0)=1, \mathbb{C}]$$

Lemma 2.1 of Abadie [2002] already establishes that the marginal distribution of treated outcomes for compliers, which we will denote $F_1(y) \equiv P(Y(\mathbf{D}^1) \leq y \mid \mathbb{C})$, is identified.

The share of compliers who are always-enrollers,

$$p \equiv P(I(0)=1 \mid \mathbb{C}),$$

is also identified via Lemma 2.1 of Abadie [2002] by:

$$p = \frac{E[(1-D)I \mid Z=0] - E[(1-D)I \mid Z=1]}{E[D \mid Z=1] - E[D \mid Z=0]}. \tag{6}$$

With these inputs, we can bound $E[Y(\mathbf{D}^1)|I(0)=1,\mathbb{C}]$. The always-enrollers are a subpopulation of measure p within the compliers. We do not, however, know *where* within F_1 that subpopulation lies: depending on how applicants select into immediate enrollment, the always-enrollers could be the best- or the worst-performing compliers. Following Lee [2009], we bound the expectation by considering these two extremes.

Define the relevant quantiles of the complier treated distribution,

$$y^p \equiv \inf\{y : F_1(y) \geq p\}, \qquad y^{1-p} \equiv \inf\{y : F_1(y) \geq 1-p\}.$$

The bounds are then

$$E[Y(\mathbf{D}^1) \mid \mathbb{C}, Y(\mathbf{D}^1) \leq y^p] \;\leq\; E[Y(\mathbf{D}^1) \mid I(0)=1,\mathbb{C}] \;\leq\; E[Y(\mathbf{D}^1) \mid \mathbb{C}, Y(\mathbf{D}^1) \geq y^{1-p}], \quad (7)$$

where the lower bound places the always-enrollers in the bottom p fraction of the complier treated distribution and the upper bound places them in the top p fraction. These are the tightest bounds available given knowledge of F_1 and p alone. Differencing Equation 7 against the point-identified untreated expectation of Equation 4 delivers bounds on $\lambda_{\text{always-enroller}}$.

Estimands for the bounds. Applying Lemma 2.1 of Abadie [2002], we can identify the upper bound of complier treated outcomes at any point c by:

$$E[Y(\mathbf{D}^1) \mid \mathbb{C}, Y(\mathbf{D}^1) \geq c] = \frac{E[Y\mathbb{1}\{Y \geq c\}D \mid Z=1] - E[Y\mathbb{1}\{Y \geq c\}D \mid Z=0]}{E[\mathbb{1}\{Y \geq c\}D \mid Z=1] - E[\mathbb{1}\{Y \geq c\}D \mid Z=0]}. \quad (8)$$

Setting $c = y^{1-p}$ yields the upper bound in Equation 7. This amounts to a regression discontinuity implementation using $Y\mathbb{1}\{Y \geq c\}D$ as the outcome and $\mathbb{1}\{Y \geq c\}D$ as the treatment. Setting $c = y^p$ and swapping '$\geq c$' for '$\leq c$' everywhere gives the lower bound.

Binary outcomes. Several of our outcomes are binary, in which case F_1 has discrete mass at each of its two support points and the quantiles above are degenerate. The bounds implied by Equation 7 then reduce to a convenient closed form. Writing $\mu_1 \equiv E[Y(\mathbf{D}^1)|\mathbb{C}]$ for the complier treated mean, we have:

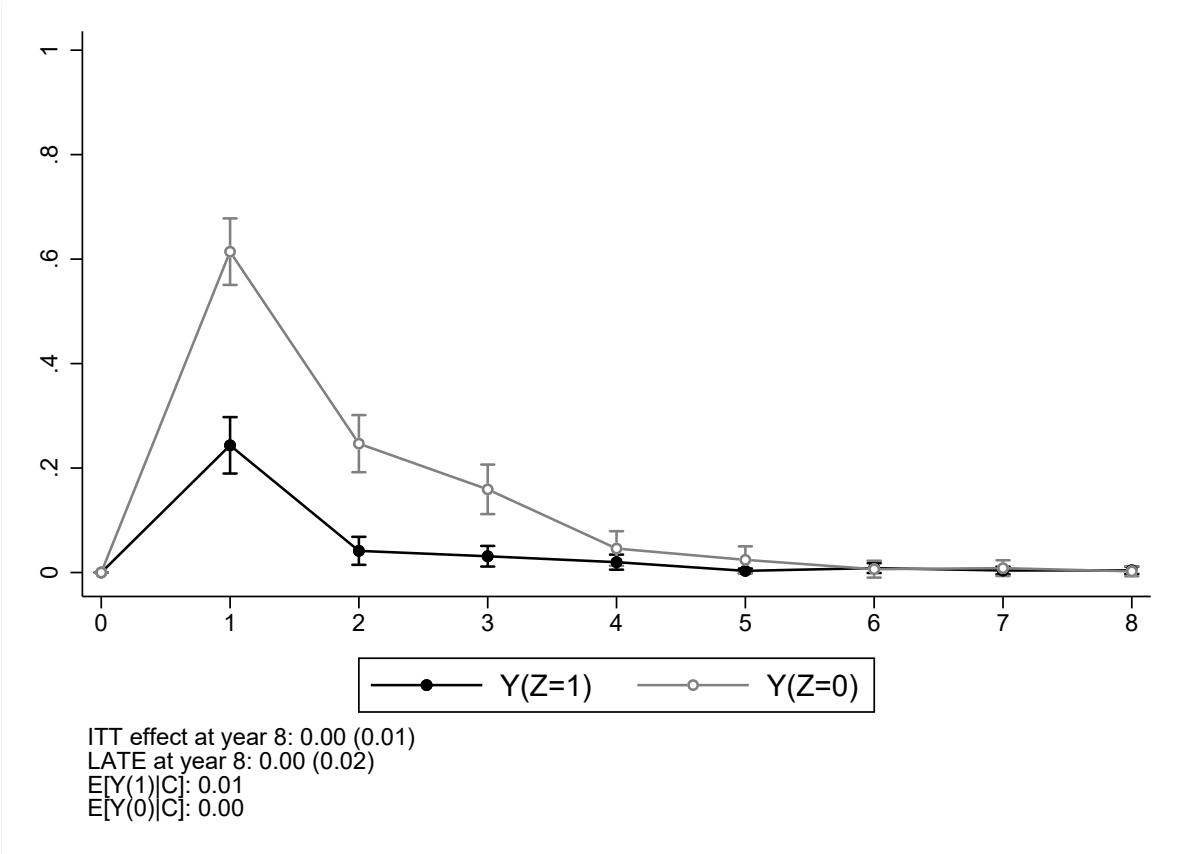
$$\max\left\{0,\, \frac{\mu_1 - (1-p)}{p}\right\} \;\leq\; E[Y(\mathbf{D}^1) \mid I(0)=1,\mathbb{C}] \;\leq\; \min\left\{1,\, \frac{\mu_1}{p}\right\}. \quad (9)$$

The upper bound assigns as much of the complier mass at $Y = 1$ as possible to the always-enrollers, and the lower bound assigns as little as possible.

D Delaying education start

Marginal applicants who fall just below the admission threshold may not give up on their goal of studying medicine in Norway, and they reapply to medical school up to five years after their initial application. Figure D8 shows that individuals who fell just below the admission threshold continue reapplying even 5 years after the initial application.

Figure D8. The effect of threshold crossing on the likelihood of reapplying to medical school in Norway



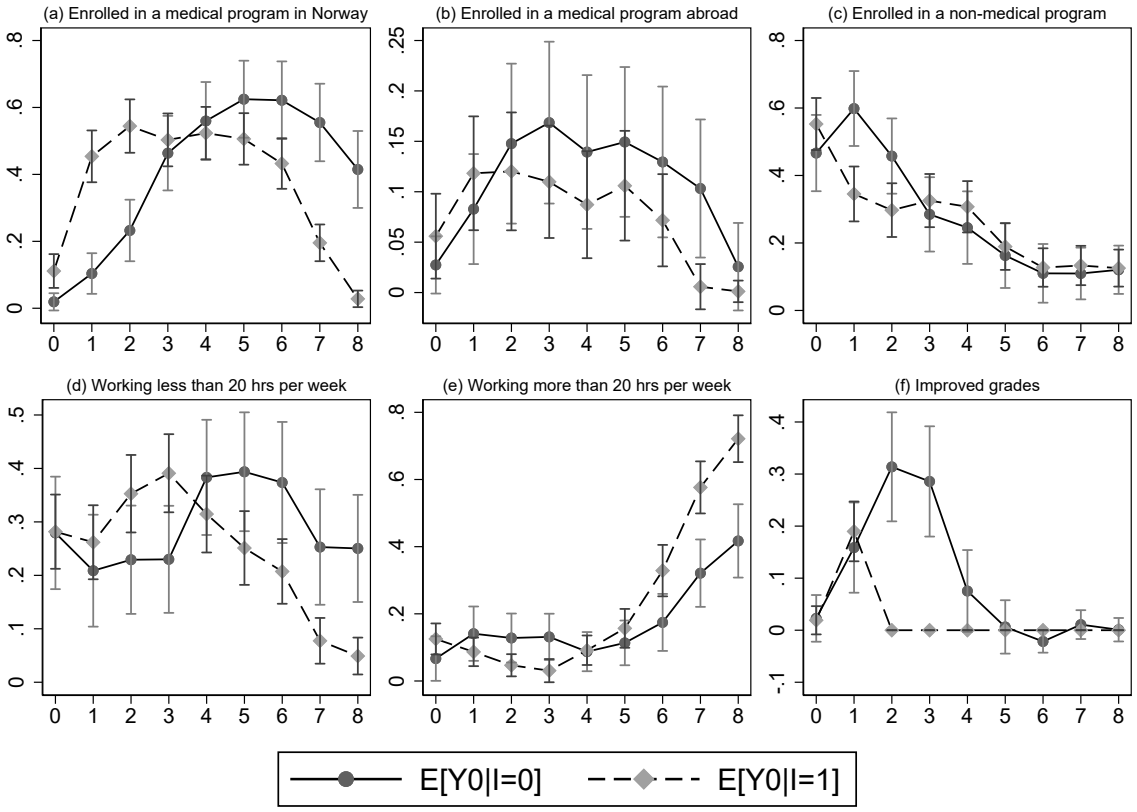
Note: Each series graphs the expected probability that a complier submits a new application to a Norwegian medical program, by year since the initial application, under admission ($E[Y(1)|C]$) and under rejection ($E[Y(0)|C]$). Complier expectations are calculated using Abadie's method [Abadie, 2002]. The effect reported below the panel is the difference between the two series in year 8, with its standard error in parentheses. Vertical bars denote 95 percent confidence intervals.

In addition to the age points awarded to applicants older than 19, one may increase one's chances of admission to a competitive program by:

1. Improving GPA from upper-secondary school
2. Taking higher education courses
3. Completing military service/attending folk schools etc.

To investigate to what extent different pathways to gain extra points are used by the marginal applicants to medical schools in Norway, we graph different outcomes separately for the group who stopped reapplying one year after application (immediate enrollment) and the group who continued reapplying two years after the initial application or later (late enrollment). Figure D9 shows that both improving grades and taking higher education courses are widespread among individuals in both groups. The likelihood of reapplying to medical school with improved grades is around 30% two years after the initial application among individuals who continue to reapply after year 2. We may also observe from plot (b) that starting an education abroad does not necessarily mean one stops reapplying to medical schools in Norway.

Figure D9. The relationship between various outcomes and falling below the admission threshold among individuals who either stopped or continued reapplying 2 years after application



Note: Each panel graphs expected *untreated* outcomes by year since the initial application, separately for compliers who enroll immediately if rejected ($E[Y(0) \mid I = 1]$, dashed) and compliers who delay ($E[Y(0) \mid I = 0]$, solid). Panels (a)–(c) report enrollment by type of program, panels (d)–(e) report weekly hours worked, and panel (f) reports the share who reapply to a Norwegian medical program with an improved upper-secondary grade point average. Complier expectations are calculated using Abadie's method [Abadie, 2002]. Vertical bars denote 95 percent confidence intervals.

We cannot observe labor market outcomes for individuals who delay starting their studies. In Section 6 we describe the approach we use to separate out the effect for compliers who delayed their medical education and whose outcomes we are unable to observe.