University admission and preferred field of study

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Using regression discontinuities from the Danish college enrollment system, we find that students who marginally gain acceptance into their preferred program in a broad field that is different from their next-best choice (e.g., business rather than science) experience significant rewards for doing so, whereas students whose preferred and next-best degrees lie within the same broad field do not. We provide evidence that the former sort according to comparative advantage whereas the latter do not. Furthermore, the positive effects they experience are not driven by a motivation effect. Our results suggest that students ought to target admission in narrow fields within a broader discipline rather than waiting a year to reapply to their preferred narrow field or listing a program in another discipline as a fallback option. Moreover, policymakers ought to consider a marginal lowering of GPA admission requirements with an eye toward admitting as many students as possible into at least one program within their preferred broad discipline.

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1. Introduction

In most of Europe, students decide which program they would like to enter when they apply for university admission. Students must often make a constrained choice, as the number of available slots in a program is restricted. Usually program admission is restricted by imposing a minimum necessary high school grade point average (GPA) required for admission. Using Danish register data, we ask whether exceeding the admission requirements of one's preferred field has an effect on one's future earnings and whether this effect is a function of the similarity of the applicant's preferred and next-best alternatives. Answering such questions will play a crucial role in determining the optimal skill distribution of tomorrow's workforce.

If applicants realize gains from exceeding the GPA threshold stemming from comparative advantage, there may be room for improvement in the allocation of spots in the Danish university system. Policymakers ought to consider marginally loosening the GPA entrance requirements as long as the marginal benefits exceed the marginal costs of doing so. Moreover, if students are strongly penalized for not being admitted into at least one program within their preferred broad field of study (e.g., social sciences, sciences, humanities) but are unaffected by admittance decisions across specific fields of study (e.g., archaeology and history), policymakers should change admission thresholds accordingly.

As the Danish college enrollment system satisfies the conditions of a regression discontinuity design, we are able to visually confirm and cleanly estimate the causal effect of just exceeding the GPA threshold of one's preferred degree on several measures of future earnings. We estimate that threshold-crossing increases future earnings for applicants whose next-best field of study lies in a *different* broad field. In fact, we see a clear discontinuity in earnings at the admission

cutoff when plotting earnings against the distance to the admission cutoff. Furthermore, we find that positive earnings effects result from exceeding the GPA admission threshold for every broad field aside from the humanities and life sciences. We provide evidence that these students sort according to comparative advantage, in agreement with the findings of Kirkeboen et al. (2016), who use Norwegian data. Given our longer observation window, we are able to show that these average positive effects persist over time. The total effect on earnings within the first 15 years after enrollment is roughly equivalent to one year's average salary and is highly significant. On average, these pecuniary benefits exceed the marginal costs associated with reallocating the marginal student to her preferred degree program.

Applicants whose preferred and next-best degree choices lie within the *same* broad field (e.g., a preferred field of chemistry and next-best field of biology) see no increase in earnings from surpassing the GPA requirement of their preferred degree and do not seem to sort based on comparative advantage. Finally, a large fraction of applicants apply for admission to just one field of study. For these applicants, not exceeding the GPA requirement necessary for admittance translates into significant earnings losses, mainly because of a delay in enrollment. The effect on total earnings within 15 years of enrollment for those applicants who just exceed the admission threshold is large, positive, and significant: Earnings lost while studying are more than offset by earlier entry into the labor market.

The immediate policy implication of our results is that the GPA requirements should be marginally lowered, with a particular focus on ensuring that applicants are accepted to a program within their preferred broad field. Whereas other studies have focused on just those applicants whose preferred and next-best fields lie in different broad fields (Kirkeboen et al., 2016) or pooled all applicants together (e.g., Hastings et al., 2013; Heinesen, 2018; Öckert, 2010; & Humlum et

al., 2017), we believe that we are the first to categorize applicants in this policy-relevant way.

By separating applicants according to the similarity of their preferred and next-best degree, we further the understanding of what is driving the observed increase in future earnings resulting from admission threshold crossing. If programs within the same broad field tend to reward similar skills, the Roy model predicts that individuals whose preferred and next-best fields lie in different broad fields ought to realize larger gains relative to those whose preferred and next-best fields lie within the same broad field. As an example, the skills employed by archaeologists and historians are relatively similar, whereas the skill set employed by archaeologists and those who work in business are relatively different.

However, the psychology literature suggests that individuals' passion and motivation affect their academic performance (Stoeber et al., 2011). If this is true, being admitted to one's preferred program could potentially, in itself, give rise to a motivation effect—which, if long-lasting, could have effects on labor market earnings. The level of general motivation for one's preferred field is likely unrelated to one's next-best alternative. As such, if this motivation effect is important and has implications that last beyond university studies, we would expect to see a positive earnings effect from being admitted to one's preferred degree program for *all* applicants. The fact that we only see significant positive earnings effects for persons whose next-best field lies within a different broad discipline suggests that this effect is primarily driven by comparative advantage and that a general motivation effect of being admitted into one's preferred field plays a negligible role in the labor market.

The literature using a regression discontinuity design to study the effect of post-secondary education generally finds significant positive effects on graduation of being admitted into one's preferred field. However, evidence is mixed with respect to the findings on earnings. For example, Öckert (2010) finds low or no

earnings effects for Sweden, whereas studies examining the effect of being admitted to higher-quality institutions find substantial effects for the U.S. (Hoekstra, 2009), for Columbia (Saavedra, 2008), and for Italy (Anelli, 2016).

Recently, Hastings et al. (2013) and Kirkeboen et al. (2016) have analyzed the effect on earnings of either being admitted to or completing one's preferred broad fields of study. Hastings et al. use Chilean data to estimate the intention-to-treat (ITT) of meeting GPA admission criteria. They find large effects of being admitted to a highly selective program as well as generally large effects across degree, excepting education, art and architecture, and the humanities. In order to identify these effects, the authors had to make some relatively strong assumptions about applicant behavior. Rather than estimating ITT effects, Kirkeboen et al. focused on estimating the effects of completing various broad degree types. Using data on next-best alternatives, they were able to identify these effects under a more realistic set of behavioral assumptions. In addition to providing pairwise payoffs for preferred and next-best broad degrees that demonstrate a high level of variability, they provide evidence that students sort according to comparative advantage.[1]

Finally, two recent studies use the regression discontinuity design in the Danish college enrollment system. Humlum et al. (2014) estimate the causal effects of exceeding the admission requirements of one's first-choice program on the timing of university enrollment, educational outcomes, and how these factors relate to family formation. They find that threshold-crossing increases the speed with which students enroll in and complete university, enter the labor market, and begin a family.[2,3]

[1] See Altonji et al. (2016) for a thorough discussion of Hastings et al. and Kirkeboen et al.

[2] We use the term "preferred field" as in Kirkeboen et al.'s (2016) study. It differs from first-choice field, which is simply the first field listed on the application. Whereas the former corresponds to the applicant's realistic choice set, the latter needs not. See section III B for more detail.

Heinesen (2018) studies the effect of crossing the standby admission threshold (i.e., the threshold for admission in the following year rather than the main admission threshold that allows for enrollment in the current year) of one's first-choice program on completion and earnings. While he finds no robust effects of exceeding the standby GPA requirement on earnings 11 years after application, he does find an increase in the probability of completing a master's degree in that subject. He also briefly considers the effect of crossing the immediate admission GPA cutoff for admission to one's first-choice program and finds significant earnings effects in the sample closest to ours.[4]

Our work most closely aligns with the approaches and questions asked by Hastings et al. and Kirkeboen et al. More specifically, our data allow us to take full advantage of the information present in the preferred and next-best alternatives, as Kirkeboen et al. have done, so that we may identify the effects we are studying under relatively weak and realistic assumptions about the behavior of students.[5] Like Kirkeboen et al., we explore the degree to which comparative advantage can explain the earnings effects that we estimate, and we are able to both corroborate and extend their findings. Unlike Kirkeboen et al., but like Hastings et al., we estimate the ITT effect of exceeding the GPA admission criteria as we are ultimately interested in informing policy.

The paper is organized as follows. In section 2, we discuss the institutional details of higher education in Denmark. In section 3, we consider the econometric framework employed in this paper. We describe the register data in section 4 and provide simple descriptive statistics. In the following section, we provide a

[3] Their results agree with our finding that those applicants who apply to only one field and exceed the GPA requirement for admittance into that program are able to complete their programs earlier.

[4] See the bottom of Table D.1 in his online appendix and note that his estimates are reported in year 2000 DKK.

[5] In addition to Kirkeboen et al, see Altonji et al. (2016) for an excellent discussion of the importance of using information on next-best alternatives.

graphical checks of the research design, while we present our results in section 5. Section 6 concludes the paper.

2. Institutional Details

In Denmark, children must attend compulsory schooling for nine years, usually from the age of seven to sixteen. After completing compulsory schooling, more than half of a cohort completes a 3-year high school program, a precondition for admittance into a university or professional bachelor's degree program.[6] Studying in Denmark is comparatively cheap: University programs are publicly provided and are free of charge. In addition, the government provides generous student grants and optional student loans with favorable terms.

As in most of Europe, Danish students make their choice of study program when they apply for admission to university. A program identifies a field (e.g., economics) and an institution (e.g., University of Copenhagen) combination. All applications to university programs are handled by a centralized admission system. Once an applicant has been admitted to a program, generally speaking, the only way for her to change her program is to apply through the centralized application system in the following year. However, if she would like to change to a program that has vacant slots, she may do so in the current year without reapplying.

During the period we are studying, universities determined the maximum number of students who could be admitted into each program of study.[7] The

[6] There are a few exceptions to this requirement. For example, the School of Visual Arts admits students based on artwork and a vocational education qualifies applicants for admittance into a professional bachelor's program such as a building construction program.

[7] There a few exceptions to this practice. A small number of university programs have a maximum number of students set at a central level. For example, as medicine involves mandatory practice, universities cannot determine the size of the incoming class. Beginning in 2014, a centralized system determines the maximum number of students per program based on projections of the labor demand for each field.

number of available slots in a program is determined prior to the period of application. Some programs also have a course-specific admission requirement, which naturally is determined prior to the period of application.[8]

If, after the application deadline, the number of applications exceeds the number of available slots, admission to a program is restricted and only applicants whose high school GPA exceeds a cutoff will be admitted.[9] Programs with fewer applicants than available slots will have open admission; i.e., no GPA cutoff. About half of all programs have a GPA admission restriction. In practice, this cutoff is the binding constraint facing the vast majority of applicants who are not admitted to a program.

An applicant may list up to eight preferences in her application each year. If her GPA exceeds the GPA cutoff for her first-choice program, she is admitted and will not be considered for lower priorities. If she does not meet the GPA requirement for her first choice, she will be considered for her second-choice program. This process will continue down her preference rankings until she is admitted to one of her listed programs or receives no offer of admittance. In this way, the best students will be offered their preferred education.

The GPA admission requirement changes from year to year, mainly due to variance in applicant pools and, to a lesser extent, because of changes in the number of available slots. As a consequence, applicants do not know the exact GPA cutoff when applying. In particular, an applicant with a high school GPA close to the previous year's GPA requirement will not be able to predict whether or not she will be accepted.[10]

[8] An example of a course-specific admission requirement is that the applicant has passed high-level (A-level) math in high school.

[9] We focus on applicants in the period of 1996–2006, during which the Danish educational system used a 10-point grading scale with integer values between 0 and 13. Since then, a 7-point grading scale has been introduced.

[10] Humlum et al. (2018) provide a valuable discussion of time variation in the Danish admission requirements. They demonstrate the high degree of time variation during the application years that we consider.

The admission system just described is usually referred to as the Quota 1 application system. Some programs also offer slots through Quota 2. To be eligible to apply through Quota 2, the applicant must have collected a sufficient number of points in a point-based system in which activities such as work experience, organization and political work, military service, and living abroad are rewarded. The specific criteria and the share of slots available in Quota 2 are decided at a decentralized level. If a Quota 2 applicant has a higher GPA than the Quota 1 GPA cutoff, she will be admitted through Quota 1. Thus, the benefit of applying through the Quota 2 system is that the high school GPA requirement is lower than the Quota 1 GPA requirement.

As mentioned, if an applicant is not admitted to any of her listed priorities, it is still possible to enroll in programs with vacant slots. In addition, some programs also offer standby slots. Standby slots require a lower GPA cutoff than the Quota 1 slots and offer admittance into the program in the following year.

More than three-quarters of applicants are admitted through Quota 1, which seems to suggest that this is the most relevant cutoff to consider. Nevertheless, our main argument for using the Quota 1 cutoff and not the standby cutoff is that lowering the latter would imply that more students would have to wait for a year before beginning university studies. From a policy perspective, it is clearly more attractive for both society and the individual to admit students in the current year rather than postponing their studies.

The existence of standby slots, the Quota 2 system, and the applicant's ability to reject an offered slot imply that we do not have a sharp regression discontinuity design, even for enrollment. From a policy point of view, the main question of interest is the effect of changing the GPA cutoffs on earnings.

3. Econometric Specification

We estimate the causal effect of exceeding the (Quota 1) GPA requirement of one's preferred field of study (hereafter cutoff) on earnings. This is the intention to treat effect (ITT) of admittance into one's preferred program. We will estimate

$$y_{it} = \beta \mathbb{I}(r_i > 0) + f(r_i) + \alpha x_{it} + \varepsilon_{it} \quad (1)$$

where y_{it} is individual i's earnings in year t, and r_i is the difference between an individual's high school GPA and the GPA cutoff of his or her preferred program, normalized by the standard deviation of GPA. $\mathbb{I}(r_i > 0)$ is an indicator function taking the value of one if an individual's GPA exceeds the cutoff of the preferred program. We estimate various specifications of $f(r_i)$ including linear, quadratic, and an interaction between r_i and $\mathbb{I}(r_i > 0)$. Finally, we control for a set of predetermined variables, x_{it} including sex, the earnings of the applicant's father at age 16, an indicator for whether or not the father's earnings is missing, age, age squared. Also included in x_{it} are a set of calendar year indicators, a set of application year indicators, a set of preferred narrow field indicators, a set of next-best narrow field indicators, a set of preferred institution indicators and a set of next-best institution indicators.

As long as the requirement of a (fuzzy) regression discontinuity design are met in the Danish application process, applicants are locally "as good as randomly assigned" to being above or below admission cutoffs within a narrow enough window of the application score. Subject to an appropriately specified running variable (application score), we can interpret any discontinuous jumps in earnings as the effect of meeting the GPA admissions requirement. Intuitively, the difference in earnings between applicants whose GPA is right above and below

the admission thresholds can be interpreted as the causal effect, β, of having a GPA that exceeds the admission requirement.

Our running variable is discrete, thus we have a non-negligible mass of applicants with an application score of zero. To address this issue we drop applicants whose application score is zero prior to estimation, that is, we employ the so-called "donut-RD" estimator as used by Barreca, et al. (2011), though our results are not sensitive to this.

After carefully examining evidence that the requirements for the regression discontinuity design are met in the Danish enrollment system, we estimate equation (1) with OLS using standardized application score windows of 2, 1 and 0.5.

The average effect on earnings, over individuals and time, of meeting one's preferred GPA requirement is captured by β. We would also like to understand how these effects evolve over time. To do so, we will also estimate equation (1) for each year after application, starting with seven years after application.

Next we estimate the local average treatment effect (LATE) on earnings of exceeding the GPA admissions requirement of one's preferred program conditional on having completed a Master's degree. Using instrumental variable (IV) , we estimate:

$$y_{it} = \alpha CP_i + f(r_i) + x_{it}\alpha + \varepsilon_{it} \tag{2}$$

$$CP_i = \gamma \mathbb{I}(r_i > 0) + f(r_i) + x_{it}\theta + \epsilon_{it} \tag{3}$$

where CP_i is an indicator variable taking the value one if the individual completes a Master's degree in his or her preferred program. We estimate the effect of completing a master's degree in one's preferred degree using two-stage least squares (2SLS). This means that we use the discontinuous jump in the probability

of graduating at the GPA cutoff to identify the effect in a fuzzy regression discontinuity framework.

To interpret the parameter estimate as a local average treatment effect (LATE) in a heterogeneous effect framework, the standard LATE assumptions need to hold.[11] First, the instruments (i.e. an indicator variable taking the value of 1 if one's GPA exceeds the GPA admission requirement for one's preferred field) must be "as good as randomly assigned", which implies that it is independent of potential earnings and potential graduation. Furthermore, the monotonicity assumption must hold: although some individuals may not be affected by the value of their instrument, all those who are affected by the instrument are affected in the same direction. Finally, the usual rank condition must be satisfied. We provide both graphical and first stage evidence supporting the validity of the instruments.

Next we ask whether the similarity of an applicant's first and next-best programs affect the earnings consequences of meeting one's preferred degree admission requirement? To answer this question, we classify applicants into three types: those who apply to *only one* field; those whose preferred and next-best fields belong to two different broad fields, that is, are on the margin of acceptance *between* two different fields (e.g. have a preferred broad field of Social Science and a next-best broad field of Law); and those applicants who are on the margin of acceptance between two fields *within* a broad field (e.g. have a preferred narrow field of Anthropology and next-best narrow field of Sociology, both of which lie within the broad field of Social Science). Between applicants are the subject of Kirkeboen et al., but, as discussed in the data section, comprise only about a quarter of the Danish applicant pool.

We generalize equation (1) to allow the ITT to depend on applicant type,

[11] See Angrist and Pischke (2009) and Kirkeboen et al. (2016).

$$(4) \qquad y_{it} = \sum_{j \in O,W,B} \left[\beta_j \mathbb{I}(r_i > 0) * \mathbb{I}(type = j) \right] + f(r_i) + \alpha x_{it} + \varepsilon_{it}$$

where now our vector of control variables also includes indicators for applicant type. The pool of applicants who list only one program are denoted by O, those whose preferred and next-best fields are within the same broad field are denoted as W, those who are on the margin between two different broad fields are denoted by B. We also estimate, using 2SLS, a generalized version of equations (2) and (3) which allows the effects of completing one's preferred degree to vary according to one's type.

4. Data and Descriptive Statistics

4.1 Data

Fundamental to our analysis is the availability of detailed information on student preferences over programs of study at time of application, where program identifies a field (e.g. economics) and institution (e.g. University of Copenhagen) combination. The Coordinated Enrollment System (CES), by which all college applications are processed, has provided this data from 1993 to 2014 for all applicants along with each applicant's personal identifier, a key by which additional register data can be merged. Statistics Denmark maintains several high quality administrative registers that cover virtually the entire population of Denmark. Demographic characteristics are taken from the population registers which are available from 1980 onward. Earnings and income histories are taken from the income registers which are available from 1980-2014 and high school GPA is taken from the education registers. All estimations contain (some function of) an applicant's standardized GPA score, calculated as the difference between her GPA and the GPA admission requirement for her preferred degree normalized

by the standard deviation of GPA scores, referred to as her application score. Unfortunately, GPA is recorded to the first decimal place only, in this sense our running variable is discrete. In the case of a discrete running variable, Lee and Card (2008) recommend clustering the standard error on the discrete values of the running variable. Earnings may also be correlated within program type. Following Heinesen (2018) and Humlum et al. (2017), we cluster on preferred program as this appears to be more conservative.[12]

Our measure of total earnings includes wages and self-employment income, and mandatory pension contributions. Monetary figures are shown in 1000s of 2015 DKK.[13] We consider the effects on earnings seven years after application and beyond.

The identification system for programs used by CES is different from the identification of programs in the education registers. As one of the treatments in our context is completing a degree in a particular field, this link must be constructed. Less than ten percent of individuals could not be mapped. It is important to note however that many of these individuals preferred a program with no admission requirements, and thus would have been dropped anyway, a point discussed below in Sample Selection.

We use pre-determined demographic variables to verify the validity of the regression discontinuity design as well as to increase power in our estimations: sex, paternal earnings measure defined when the applicant was 16, and an indicator if paternal earnings are missing.

[12] Estimation results from using the running variable to cluster standard errors are presented in the appendix.

[13] An approximate exchange rate of 1USD to 6.5DKK can be used.

4.2 Preferred and Next-best Fields

As in Kirkeboen et al., we use the notion of *preferred field,* defined from the local course ranking around an applicant's GPA rather than the first-choice field (i.e. the field which is given first priority).[14] Changing the focus from preferred field to first-choice field (as well as implied sample selection criteria discussed below) does not significantly alter our results, a consequence of the fact that the vast majority of Danish applicants list few programs.

From the *program* level priority ranking we aggregate preferences to the narrow *field* level and assign the minimum GPA requirement. For example, if an individual applies to the University of Copenhagen's Sociology program with GPA admission requirement of 9.0 and Aarhus University's Sociology program with GPA admission requirement of 8.7 these two individual preferences would be aggregated to a narrow field of Sociology with minimum GPA requirement 8.7. This aggregation is performed in the same way as in Kirkeboen et al. except that we aggregate at a rather narrow definition of field (e.g. Sociology) whereas Kirkeboen et al. aggregates at a rather broad definition of field (e.g. Social Sciences).[15]

4.3 Sample Selection

We consider Danish first-time applicants between the ages of 17 and 25 with non-missing high school GPAs who applied to CES between 1996 and 2006. We use the years 1993-1995 to determine whether individuals in 1996 and later are indeed first time applicants. We do not consider applicants after 2006 because of a

[14] See Table I and discussion for more detailed explanation of the creation of preferred and next best fields. Appendix table 2 also details this process.

[15] There are 50 narrow fields of study.

large change that was made to the Danish grade scale.[16] We focus on applicants whose preferred and next-best fields are for university programs.[17]

Following Kirkeboen et al.'s construction of an estimation sample suitable for regression discontinuity analysis in this context, we drop applicants whose most preferred field does not have a GPA requirement for admission. *Between* and *Within* applicants whose preferred and next-best fields have non-descending GPA admission thresholds are also dropped, as are those whose GPA never exceeds any an admission threshold. Removing these sample selection criterion and instead focusing on first-choice fields does not alter our results substantially.

We remove individuals who completed a master's degree in less than four years after being admitted to a bachelor (3.4 percent of individuals) and observations with negative earnings or with earnings above the 97.5th percentile.[18] For most of the analysis, we use an estimation window of 2.0 application score points (i.e. standardized GPA), but also show results with a narrower window of 1.0 and 0.5. As a donut regression discontinuity estimator is used, applicants who have an application score of 0 are dropped, however results are robust to including these individuals.

The resulting sample is used for descriptive tables and figures and the intention-to-treat results. We also consider the effects of completing a preferred degree. As in Kirkeboen et al., the estimation sample used for these estimations contains only those individuals who have completed their (master's) degree and the years after graduation. Detailed descriptions of both of these samples are provided in the

[16] The grade system was changed from a 10-point to 7-point scale. See the English website for the Danish Ministry of Education for more detail.

[17] We remove immigrants as information on GPA or other demographics are not available, i.e. earnings of parents at age. See table A1 for a detailed description of the basic cleaning performed.

[18] If one complete a master's degree in less than four years it is likely that the student was admitted previously, or equivalently, that the student has studied a similar field in another country.

appendix tables A1, A2 and A3. Equivalent descriptive statistics for the estimation sample used to estimate the effects of completing one's preferred degree are provided in the online appendix.

4.4 Descriptive Statistics

About half of all individuals who applied through CES between 1996 and 2006 listed just one preferred program, about 22 percent listed two programs and 17 percent listed three programs. Less than six percent listed four or more programs despite the ability to list up to eight. Aggregating preferences and imposing some basic cleaning, the share of individuals applying to one field increases to almost 60 percent. The share of individuals who are on the margin between two different (same) broad fields is about 26 (16) percent.

Panel (A) of Table I presents descriptive statistics, by type of applicant, calculated from the main estimation sample. Panel (B) displays descriptive statistics for the full sample of first-time applicants after basic cleaning and the removal of individuals who just have preferences for non-university educations. The rightmost columns of Panel (A) display the descriptive statistics for the estimation sample as a whole.

There are 47,033 individuals who meet the selection criteria and are thus included in the estimation sample. The average age at application is 19.85 years old. Almost 60 percent of applicants are female. Applicants list an average of 1.41 narrow fields and 1.36 different institutions. 61 percent of applicants are offered their first priority whereas 26 percent receive no offer. Comparing these columns with the equivalent figures for the full sample in panel (B) reveals that the two samples are rather similar, i.e. earnings 8 years after application are effectively identical, though the estimation sample is perhaps positively selected: applicants

in the estimation sample tend to have higher application scores, slightly more educated parents with higher earning fathers.

The first six columns of panel (A) present statistics by applicant type. From the bottom row of the table, we see that almost 75 percent of the individuals in the estimation sample are single program applicants, as opposed to the 60 percent of the dataset before imposing sample selection criterion. The change in share is primarily due to the additional selection criteria places on *Between* and *Within* applicants, i.e. *Between* and *Within* applicants whose preferred and next-best fields have non-descending GPA admission thresholds are dropped.

Comparing summary statistics across applicant type in the first six columns of panel A reveals noticeable differences. Relative to *Only One* or *Between* applicants, *Within* applicants make approximately 50,000 DKK less eight years after application, are more likely to be women, and have fathers who tend to earn less. Whereas one in two *Between* and *Within* applicants will be offered their first priority and 10 percent will receive no offer at all, 65 percent of *Only One* applicants will be offered their first (and only) priority.[19]

Columns (3) and (4) in Panel (A), describing *Between* applicants, is the sub-sample that most closely mimics the sample used by Kirkeboen et al. Our estimation sample contains almost 7,000 *Between* applicants, noticeably less than the 50,000 used in Kirkeboen et al. There are three main reasons for this difference in sample size. First, we focus on university educations, more than halving our sample, whereas Kirkeboen et al. includes non-university educations. Second, on average, Danish applicants list fewer preferences relative to

[19] The row titled 'No offer' in the Table I refers to the percent of individuals who did not receive an offer for admission in the current year. If instead we define 'No offer' as not receiving an offer in the current year or in the next year via standby, these numbers become 23 percent, 3 percent and 3 percent for *Only One, Between* and *Within* applicants, respectively. Note also that it is possible for an *Only One* applicant to receive an offer on second priority as the offer statistics are calculated from programs, whereas *Only One* applicants are classified as such based on field. For instance, an individual may apply to the same narrow field at two different institutions. This individual would then have applied for only one field.

Norwegians. Third, many STEM programs have no admission requirements and are consequently dropped from our analysis. For example, even conditional on having priorities for more than two broad fields, Danes ranked an average of 2.58 fields and had a final offer rank of 1.63 as opposed to Norwegians who ranked on average 3 fields and had an average final offer of 2.5.[20]

In order to better understand the differences across applicant type – and the degree to which these differences may be driven by selection criteria – Figure I displays the distribution of preferred field by applicant type for the full sample after basic cleaning and for the estimation sample (the same samples used in Table I). The term "preferred" has a different meaning in the two pictures: as the full sample is created prior to the sample selections necessary to define preferred and next-best fields, "preferred" in the full sample actually corresponds to first choice. As a vast majority have a preferred and next-best that corresponds to first and second choice, the comparison should still yield valuable information.[21]

Immediately noticeable from Figure I is the large concentration of *Within* applicants, approximately 60 percent, who have Humanities as a preferred field in the full sample. Although this share drops in the estimation sample, still more than 50 percent of *Within* applicants have a preferred field of Humanities. The large share of *Within* applicants with preferences for Humanities reconciles well with the lower earnings levels displayed for these applicants in Table I.

The estimation sample contains larger shares of applicants with preferred fields of Social Science, Medicine and Law and lower shares of applicants with preferred fields of Science, Technology and Engineering. As we drop, for

[20] Our (full and) estimation sample has relatively fewer women, 55 percent of applicants, as compared to the Kirkeboen et al. sample , 64 percent, likely as a consequence of the types of study that we consider (i.e. we do not consider nursing or many forms of teaching as they are not long educations.)

[21] Also, notice that the within type never has a preferred of Business or Law as these fields are defined from only one 6 digit education code, so given that fields are aggregated to 6 digit levels, it is impossible to have a first choice in business and second choice in business as this would be aggregated into one narrow field. Finally, the *after basic cleaning* plot is drawn conditional on having a non-missing broad education.

TABLE I: SUMMARY STATISTICS

	(A) Estimation Sample								(B) Full Sample	
	Only One		Between		Within		All		First time applicants	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Age at application	19.82	(1.45)	19.88	(1.39)	20.08	(1.43)	19.85	(1.44)	19.95	(1.47)
Female	0.58		0.55		0.61		0.58		0.55	
Earnings 8 years after application	294.84	(208.42)	299.72	(199.53)	245.01	(181.85)	290.30	(205.06)	294.74	(205.01)
Application Score	0.01	(1.02)	-0.04	(0.94)	-0.04	(0.96)	0.00	(1.00)	-0.34	(1.17)
Mother has higher education	0.51		0.53		0.53		0.52		0.46	
Father has higher education	0.48		0.49		0.47		0.48		0.43	
Father's earnings (1000DKK)	324.41	(277.38)	325.73	(258.11)	294.48	(225.37)	321.45	(269.72)	305.45	(245.72)
Fields ranked	1.00	(0.00)	2.58	(0.92)	2.64	(0.95)	1.41	(0.84)	1.72	(1.03)
Institutions ranked	1.21	(0.52)	1.82	(0.89)	1.72	(0.88)	1.36	(0.68)	1.54	(0.79)
Rank of best offer	1.05	(0.23)	1.63	(0.87)	1.60	(0.83)	1.22	(0.58)	1.23	(0.66)
Offered first priority	0.65		0.50		0.50		0.61		0.69	
Offered second priority	0.02		0.30		0.31		0.09		0.08	
Offered third priority	0.00		0.07		0.07		0.02		0.03	
No offer	0.32		0.10		0.10		0.26		0.18	
Individuals	35078		6971		4984		47033		126758	

The column titled `Only One' refers to applicants who applied for one study field. The column titled `Between' refers to applicants whose preferred and next-best fields are in different broad fields whereas the column titled `Within' refers to those applicants whose preferred and second-best fields are within the same broad fields. About 3% and 6% of mother and father education is missing, respectively. About 5% of father's earnings is missing. Monetary figures shown in 1000s 2015 DKK. The full sample first time applicants sample corresponds to the sample after basic cleaning and the removal of individual who just have preferences for non-university educations (after drop 1 in Table A2 in the Appendix) About 3% of observations don't have earnings in the 8th year after application in the estimation sample: About 17% of observations don't have earnings in the 8th year after application in the full sample of first time applicants mainly because all years are considered (not just more than 7 years after application). Offer refers to not receiving an offer in the current year.

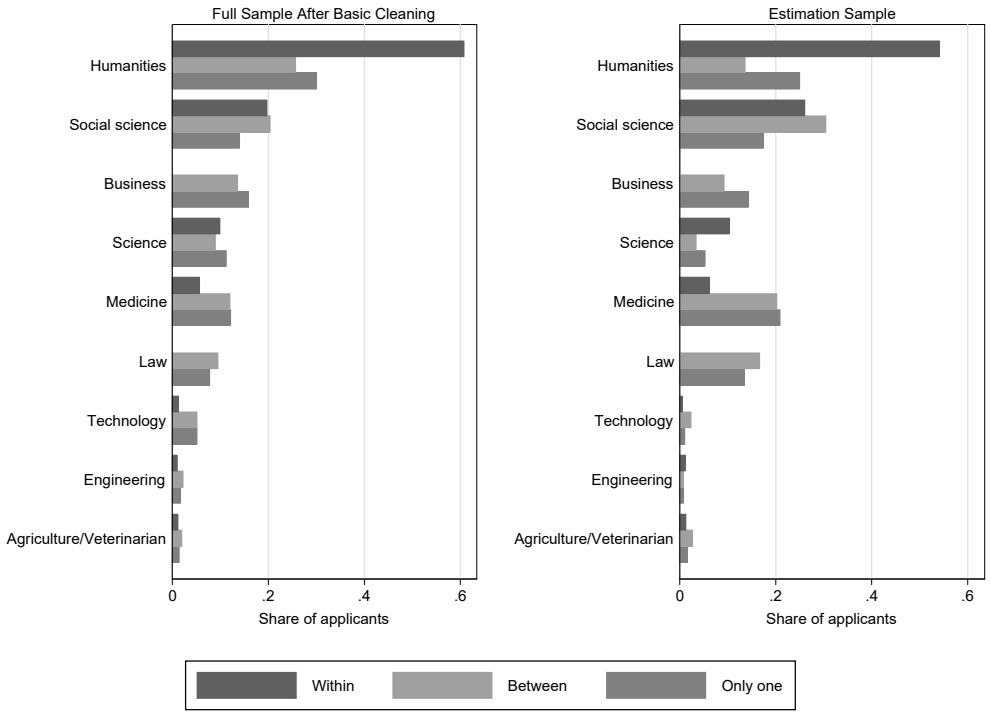


FIGURE I: DISTRIBUTION OF PREFERRED FIELD BY APPLICANT TYPE

Only one refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields.

instance, applicants who have a preferred field with no GPA admission criteria this change in distribution is expected: STEM fields are more likely to have non-binding admission requirement whereas Law, Medicine and Social Science generally have the toughest admission requirements. Online Appendix O2 contains estimation results from our main specification excluding humanities, and various other fields. Reassuringly, the results do not change substantially.

5. Graphical Illustration of Research Design

Our identification strategy relies on the discontinuity at the GPA admission giving us exogenous variation. Before proceeding to the estimation results, we will examine the graphical evidence to verify the validity of the research design and to provide a sense of the effects we expect to see. We used the naturally occurring (discrete) values of the application score rather than collapsing the data further into broader bins. All figures include a local linear regression line estimated on either side of 0 using a triangular kernel and a bandwidth of 1. As discussed in the estimation section, we dropped applicants whose GPA was equal to the admission requirement.

Figure II plots the share of applicants who are offered admission (in the current year) and complete their preferred field against their application score for each applicant type. There is a clear and large discontinuous jump in the share of applicants who receive an offer below and above 0, regardless of type. Applicants with application scores above 0 almost always receive an offer. Those whose application score falls below the required GPA admission threshold are much less likely to receive an offer. As discussed previously, the positive admission probability to the left of the cutoff results from the existence of the standby and Quota 2 cutoffs, which are lower than the Quota 1 cutoff that we use.

The strength of the discontinuous jump weakens when we look at the share of applicants completing their preferred degree, but it remains strong in the case of *Between* and *Within* applicants. *Only one* applicants are clearly more committed to studying a particular program and are likely to seek admission to this program in a subsequent year if not admitted immediately. Interestingly, the share of applicants above 0 who complete their degrees is more or less constant with respect to the application score, regardless of type, implying that one's application

score is predictive of degree completion almost only through its effect on admittance.

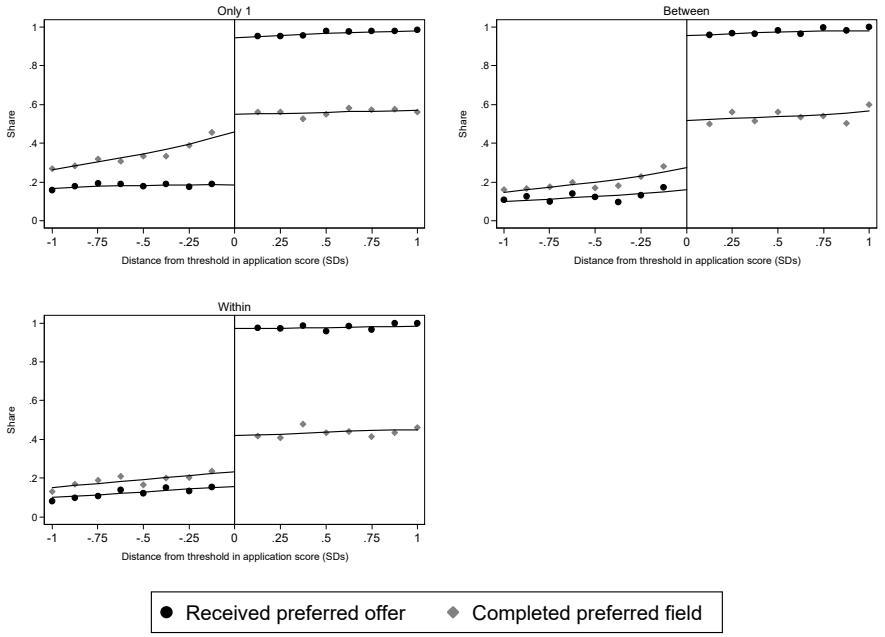


FIGURE II: ADMISSION THRESHOLDS AND PREFERRED FIELD OFFER AND COMPLETION

"Only 1" refers to applicants who applied to one field of study. "Between" refers to applicants whose preferred and next-best fields are in different broad disciplines. "Within" refers to those applicants whose preferred and second-best fields are within the same broad discipline. "Offer" here refers to an offer of admission in the current year.

The regression discontinuity design framework is only valid if individuals have imprecise control over their application score (Lee and Lemieux 2010). If we detect discontinuities in the density of the application score, we may suspect that applicants are sorting, placing the validity of the identification strategy in question. Figure III displays the log density of application scores by type, and there is no evidence of sorting. Verifying that covariates behave well (i.e., are continuous) around the application threshold can provide additional evidence that the treatment is locally randomized. Appendix B contains plots analogous to

Figure II for sex and annual earnings of the applicant's father when the applicant was age 16, and no discontinuities were detected.

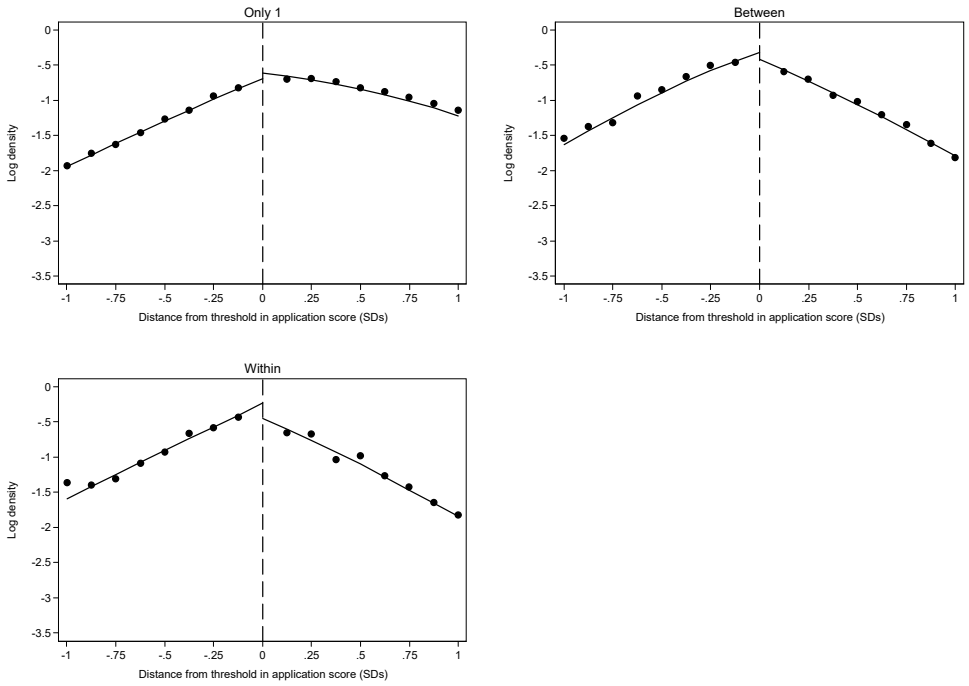


FIGURE III: BUNCHING CHECK AROUND THE ADMISSIONS CUTOFFS

"Only 1" refers to applicants who applied to one field of study. "Between" refers to applicants whose preferred and next-best fields are in different broad fields. "Within" refers to those applicants whose preferred and second-best fields are within the same broad fields.

Figure IV plots the pooled average earnings by applicant type for years 7–18 after application. The interpretation of this effect is somewhat difficult: It is the average effect over all observable years after graduation and overall program types. Rather than determining the precise magnitude of the effect, here we seek to verify a non-negligible discontinuous jump in earnings, acknowledging that the magnitude is likely to change once we begin making estimations that include factors such as specific program indicators and year of application indicators. The figure does show jumps in average earnings for applicants whose application

score exceeds the admission criteria. The greatest effects, an almost fifty thousand DKK reward per year, or around eight thousand USD, are experienced by *Only One* and *Between* applicants.

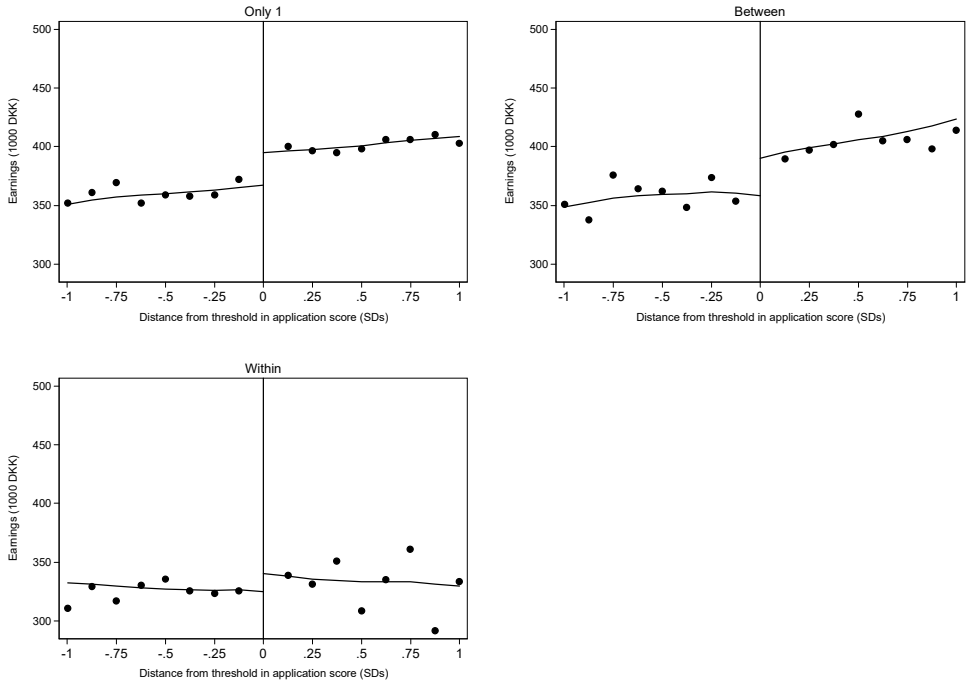


FIGURE IV: ADMISSION THRESHOLDS AND AVERAGE POST-GRADUATE EARNINGS

"Only 1" refers to applicants who applied to one field of study. "Between" refers to applicants whose preferred and next-best fields are in different broad disciplines. "Within" refers to those applicants whose preferred and second-best fields are within the same broad discipline.

Within applicants experience a very small reward for meeting the admission criteria. The takeaway from Figure IV is that we should expect to see similar rewards for exceeding admission criteria for both *Only One* and *Between* applicants, but small (if any) rewards accruing to *Within* applicants.

6. Results

6.1 Pooled Results

The first five columns of Table II present the results from estimating equation (1) using OLS. The first column displays the results for the most parsimonious model, one that includes the application score, calendar and application year indicators and indicators for (narrowly defined) first and next-best subject indicators and is estimated from a sample window of +/- 2 application score points. From the first row of regression coefficients, we see that applicants whose GPA exceeded the GPA admissions requirement for her preferred program will on average realize a highly significant 19 thousand DKK annual reward for doing so (about 3000 USD). The second column presents the least parsimonious model, also estimated from a sample window of +/- 2 application score points. In addition to the control variables included in columns 1, sex, a quadratic in age, earnings of the applicant's father at age 16 and an indicator for whether the earnings of the father are missing are included. A set of indicator variables capturing the preferred and next-best institution is included. Finally, this specification allows the function of the application score, included as a quadratic, to change on either side of zero. Again, the effect of crossing the GPA cutoff is positive and significant, and has increased by about a third relative to the parsimonious specification to almost 30 thousand DKK. These are non-negligible effects: as a consequence of surpassing the GPA requirement of one's preferred degree, applicants on average realize an bonus approximately equal to about 7 to 10 percent of annual earnings eight years after application.

Columns 3, 4 and 5 present results for a specification between the models just discussed: demographic variables, year indicators, and preferred and second-best education indicators are included. The slope of the application score is also permitted to vary above and below 0, but no quadratic in the application score is

included. No preferred and next-best institution indicators are included. Columns 3, 4 and 5 are estimated from a sample window of +/- 2, +/- 1 and +/- 0.5 application score points, respectively.

Comparing the results presented in column 3 to column 1, we can see that allowing the application score to change slope on either side of the cutoff and adding additional control variables does not affect the estimates substantially. Comparing column 3 to column 2, we see a jump in the reward to surpassing the GPA admission requirement that is either coming from the inclusion of quadratic terms in the application score or from the inclusion of first and next-best institution indicators. For clarity of presentation, a specification that teases this out – one that includes a quadratic in the running variable but not institution indicators – was not included, but the estimate from that model is a highly significant effect of 29.71 implying that the inclusion of the quadratic drives the positive jump in the ITT on earnings and the institution indicators do not affect the estimates.[22] Finally, looking across columns 3 through 5 we see that narrowing the estimation window does not substantially affect the ITT estimates. The take-away from Table II is that applicants who meet the GPA required for admission into their preferred program realize a significant 20-30 thousand DKK reward for doing so.

Intuitively, one would usually expect that the ITT estimate of admission is a lower bound on the effect of completing a Master's degree in one's preferred field. In column 5 we present estimates of the LATE of completing a master's degree in one's preferred degree relative to completing a master's degree in another field, e.g. the results from estimating equation (2) using threshold crossing as an IV for completing one's preferred degree. Recall that the estimation sample used for this exercise conditions on having completed a

[22] See appendix table C1 for this specification and more.

Master's degree, this is evident in the reduced sample size. The reward for completing a Master's degree is more than three times as large as the ITT: on average, students who complete a master's degree in their preferred field realize a 73.8 thousand DKK (more than 10 thousand USD) annual reward for doing so. Clearly it pays the average student to pursue one's preferred field of study, doing so increases annual earnings by about a quarter on average.

6.2 Results by applicant type

Given that students do better pursuing their preferred degree, we might expect that the payoffs are smaller the more similar the preferred and next-best degrees, though this need not be the case. To investigate this, we classify applicants into three types: those who apply to only one field, *Only One*; those whose preferred and next-best fields belong to two different broad fields, that is, are on the margin of acceptance *Between* two different fields (e.g. have a preferred broad field of Social Science and a next-best broad field of Law); and those applicants who are on the margin of acceptance between two fields *Within* a broad field (e.g. have a preferred narrow field of Anthropology and next-best narrow field of Sociology, both of which lie within the broad field of Social Science).

Table III presents the analogous results to Table II, except that the effect of meeting the admission criteria of one's preferred program is allowed to vary according to applicant type, that is, columns 1 through 5 of Table III present the results from estimating equation (4) with OLS. In addition to the controls used in the pooled results, indicators for *Within* applicant type and *Between* applicant type are also included.

The effects of marginally surpassing the GPA requirement of one's preferred field are quite robust to the particular specification used. *Between* applicants realize gains of about 25 to 34 thousand DKK per year on average or from 8 to 11

TABLE II: EFFECTS OF PREFERRED DEGREE ON EARNINGS

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) IV
1(Application Score > Cutoff)	19.00***	29.72***	21.73***	26.77***	22.71***	
	(4.26)	(4.61)	(3.64)	(4.30)	(3.85)	
Completed MA in Preferred Field						73.4***
						(20.8)
Observations	282,632	282,632	282,632	215,079	133,546	152,866
Individuals	43,838	43,838	43,838	33,196	20,492	29,464
Clusters	50	50	50	50	50	50
Window	2,0	2,0	2,0	1,0	0,5	2,0
Preferred and second-best education indicators	YES	YES	YES	YES	YES	YES
Control variables	NO	YES	YES	YES	YES	YES
Different slopes	NO	YES	YES	YES	YES	NO
Quadratic terms	NO	YES	NO	NO	NO	NO
Preferred and second-best institution indicators	NO	YES	NO	NO	NO	NO

The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators and indicators for year of application. Standard errors, clustered at the 6 digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

percent of annual earnings eight years after application. Likewise, the average benefit of threshold crossing of Only One applicants is from 7 to 11 percent of annual earnings. On the contrary, Within applicants see effectively zero and insignificant effects of surpassing the GPA requirement of their preferred degree.

6.3 Results by year after application

The results presented thus far consider the effects on average earnings seven years and beyond. To understand how these effects evolve over time, we estimate equations (2), (3), and (4) separately for each year, starting 7 years after the application.[23, 24] In addition, we estimate these equations including a quadratic in actual work experience.[25] Although experience is likely endogenous, we include it only to explore the degree to which our results are sensitive to time differences in the timing of labor market entry.

Panels (A) and (B) of Figure V presents the ITT and IV results respectively. The ITT results in Panel (A) reveal that the rewards realized by *Between* applicants are not just concentrated early in the work life. In fact, these applicants receive a rather constant, and predominantly significant, bonus that hovers around 25 thousand DKK per year, from seven to sixteen years after application. This is true regardless of whether or not experience is included. *Within* applicants see no statistically significant effects, again regardless of whether or not experience is included. The time profile of effects for *Only One* applicants reveals substantial time variation. The positive threshold crossing effects for these applicants is clearly concentrated early: a large downward trend in the annual bonuses to threshold crossing is evident. The level of the effects also drops early in the profile once experience is included. These facts reconcile well with *Only One* applicants realizing gains

[23] x_{it} includes the same demographic controls as well as first and next-best field indicators and year dummies.

[24] Figure A4 in the Appendix presents a similar figure to Figure IV that distinguishes between time since application.

[25] The experience variable has been created by using a worker's historical mandatory payment to the supplementary pension scheme, ATP.

TABLE III: EFFECTS OF PREFERRED DEGREE ON EARNINGS, BY APPLICANT TYPE

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) IV
Only One * 1(Application Score>Cutoff)	21.10***	32.70***	24.34***	30.39***	26.63***	
	(4.80)	(4.79)	(4.57)	(4.38)	(4.92)	
Within * 1(Application Score>Cutoff)	-2.45	7.74	-0.08	7.33	-3.14	
	(7.92)	(7.39)	(7.12)	(6.92)	(9.28)	
Between * 1(Application Score>Cutoff)	25.59***	34.12***	26.21***	27.03***	27.22***	
	(7.22)	(8.09)	(6.28)	(9.02)	(7.95)	
Only One* 1(Completed MA in Preferred Field)						110.7***
						(34.7)
Within*1(Completed MA in Preferred Field)						33.0
						(22.1)
Between*1(Completed MA in Preferred Field)						54.8***
						(18.1)
Observations	282,632	282,632	282,632	215,079	133,546	152,866
Individuals	43,838	43,838	43,838	33,196	20,492	29,464
Clusters	50	50	50	50	50	50
Window	2.0	2.0	2.0	1.0	0.5	2.0
Preferred and second-best education indicators	YES	YES	YES	YES	YES	YES
Control variables	NO	YES	YES	YES	YES	YES
Different slopes	NO	YES	YES	YES	YES	NO
Quadratic terms	NO	YES	NO	NO	NO	NO
Preferred and second-best institution indicators	NO	YES	NO	NO	NO	NO

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the function of the application score indicated in the table. Standard errors, clustered at the six-digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

to threshold crossing that are due to entering the labor market earlier. In appendix Figure A3, we explore this possibility further by plotting the running variable against the number of years to MA graduation, measured from the application year, for each applicant type. No discontinuities are detected for the *Between* or *Within* applicants, but a clear (and significant) discontinuous drop of about a quarter of a year is present at the admission threshold for *Only One* applicants.

Panel (B) displays the time profile of the estimated effects of completing a Master's degree in one's preferred field of study by applicant type from estimating equation (2) by 2SLS for each year after application, with and without including a quadratic in experience. Immediately noticeable from the *Between* time profile is the increase in the size of effects: the effect of completing a master's degree in one's preferred field is generally more than double that of simply exceeding the GPA admission criteria. First considering the baseline specification without experience, we see that *Between* applicants realize significant annual gains equal to about 15 percent of average annual earnings in years seven to eleven.[26] The effects increase in years 12 and 13 before becoming insignificant in years 14 and 15, in part because of the lack of precision of the estimate. The inclusion of experience into the estimation does not change the profile of effects much, but does lower the estimates to the point where many are no longer statistically significant. Considering the effect of completing one's master's degree in a preferred field, rather than crossing the GPA threshold required for admittance, does not change the results for *Within* applicants: no significant effects are detected in either case.

Turning finally to *Only One* applicants, we see very different effects depending on whether or not experience is included in the estimation. Not controlling for experience, we see large and significant effects equal to more than

[26] When we refer to average annual earnings we mean average earnings eight years after application as shown in Table I.

a third of annual earnings in years seven through thirteen. However, as soon as experience is included these effects drop to effectively zero and become insignificant. This picture supports the story that the gain to completing a degree for *Only One* applicants predominantly arise from entering the labor market earlier.

6.4 Present Value and Costs of Studying

Understanding the effect of marginally decreasing the GPA admission requirements on student lifetime earnings vis-à-vis the cost of reshuffling applicants across programs is central to any redesign of the college admission process. Although data limitations prevent us from considering lifetime earnings, we can consider the effects on total earnings up to fifteen years after application.[27] Table IV presents the results of estimating equation (4) using the sum of annual earnings over different horizons as the dependent variable. Columns are titled with years and the sum of earnings. For instance, in column (1) with the heading "0–6," we see the effects of just exceeding the GPA requirement for one's preferred degree on the total amount earned from the year of application to six years afterward.[28] In this column, we see that *Within* and *Between* applicants who just exceed the admission criteria for their preferred degree realize no significant gains from doing so within six years of application. This finding suggests that there is no significant difference in the fraction of applicants above and below the application threshold who are postponing college enrollment. On the other hand, those who applied to one field and marginally surpassed the admission requirements for that field earned significantly less (50 thousand DKK) during the first six years after application. The intuition here is clear: Those applicants who

[27] For simplicity, we consider a simple sum of earnings over time. The current interest rate is also effectively zero.

[28] For this exercise, we use balanced samples. For instance, for column (4) labeled "0–10," individuals were only included in the estimation if earnings were not missing for each of the years from 0 through 10 after application.

were not admitted to their preferred field postponed becoming a student and worked in the meantime.

Turning to column (2), we see that effects change when we consider the effect on the sum of earnings seven to ten years after application, by which point the majority of students have completed their education. Considering first *Only One*, we see that those who exceed the admission threshold now realize a benefit from doing so. They receive approximately 130 thousand DKK more during these four years, no doubt at least in part reflecting their earlier entry into the labor market. These gains are temporary: Total earnings in years eleven through fifteen, shown in column (3), are not significantly different for those who just exceeded the admission threshold relative to those who fell short. Columns (4) and (5) present the effects on total earnings from the year of application to ten and fifteen years after application, respectively. Despite their foregone earnings while in school, *Only One* applicants still realize a significant 175 thousand DKK (a bit more than 25 thousand USD) bonus to their total earnings within the first fifteen years of application. This bonus is non-negligible: It is close to 60 percent of their average earnings eight years after application.

Focusing now on the second row of Table IV, we see that *Within* applicants realize no significant effects from surpassing the admission requirements of their preferred field, regardless of the horizon. This finding contrasts sharply with the effects realized by *Between* applicants shown in the third column of Table IV. Those *Between* applicants who just exceed the admission requirement for their preferred degree are significantly rewarded, receiving almost 100 thousand DKK more within 7 to 10 years after application and 125 thousand DKK more within 11 to 15 years after application. *Between* applicants fortunate enough to just exceed the admission requirement of their preferred program realize a highly significant boost in their total earnings within the first fifteen years after

application that equals approximately 280 thousand DKK, or 45 thousand USD, the equivalent of an entire year's worth of earnings.

If the marginal cost of reallocating applicants into their preferred fields is less than the marginal benefit of doing so, policymakers ought to marginally lower admission criteria.[29] Our best estimate of the marginal benefit of exceeding the admission requirement of one's preferred degree is provided in column (5) of Table IV. Of course, this measure captures only the pecuniary effects. In reality, the benefits received by applicants who meet the admission requirement of their preferred degree may be higher if they also enjoy nonpecuniary benefits from pursuing their preferred degree.

As discussed earlier, the benefits received by *Only One* applicants mainly stem from earlier enrollment. The small discontinuity for this applicant type shown in Figure II suggests that individuals who are not accepted in the first year of application reapply for the same program in the following year, implying that the marginal cost of admitting slightly more individuals immediately ought to be close to zero. Similarly, *Within* applicants affected by a marginal loosening of the GPA admission requirement would be reallocated to another narrow field within the same broad area. As narrow fields within the same broad discipline have effectively the same cost, the relevant marginal-cost measure of these applicants is also zero.

The possibility of a non-zero marginal cost comes into play when considering a marginal loosening of GPA requirements for *Between* applicants. Several scenarios are possible. First, if there is a symmetrical reallocation of the applicants across broad fields, then the aggregate marginal cost would remain zero (e.g., the number of applicants right below the cutoff for their preferred field of business whose next-best field is science would equal the number of applicants

[29] Here we assume that policymakers only consider the pecuniary benefits flowing to students.

right below the cutoff for their preferred field of science whose next-best field is business). To the extent that this is not true, we can place some bounds on the level of the marginal cost. Generally speaking, the most expensive students to educate are those in the sciences and medicine, whereas the least expensive students to educate are those in the social sciences and humanities. The cost of shifting a student from science or medicine to humanities or social sciences, an upward bound on the cost of switching any applicant, would be around 250 thousand DKK, still less than the marginal benefit at fifteen years.[30] Regardless of applicant type, marginally lowering the GPA admission requirements is cost-effective.

6.5 Results by broad field

Thus far, we have established that exceeding the GPA requirement for admission into one's preferred field increases future earnings for applicants whose preferred and next-best broad fields are different (*Between* applicants) and those applicants who apply to only one broad field (*Only One* applicants). Those applicants whose preferred and next-best broad fields are the same (*Within* applicants) see no changes in their future earnings.

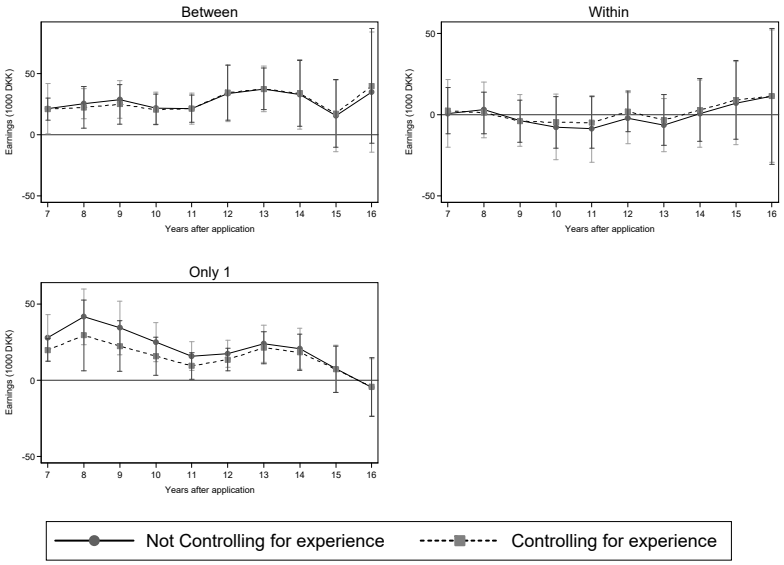
Before we draw any policy conclusions, we need to investigate whether the threshold crossing effects for *Between and Only One* applicants are general effects or whether they are just driven one or two broad fields.

We will estimate: (5)

$$y_{it} = \sum_{j}\sum_{k}\left[\beta_{jk}\mathbb{I}(r_i > 0) * \mathbb{I}(type = j) * \mathbb{I}(field = k)\right] + f(r_i) + \alpha x_{it} + \varepsilon_{it}$$

[30] Our own calculation based on data from *Universiternes Statistiske Beredskab*. We calculate the costs using the so-called taximeter funding. This funding increases at a fixed rate in the number of students. Different rates exist, depending on the field of study. In addition, universities are financed by basic research funding and competitive research grants. Neither of these types of research funding is directly related to the number of students in a field. We thank Fane Groes for sharing this data.

(A) ITT ESTIMATES



(B) IV ESTIMATES

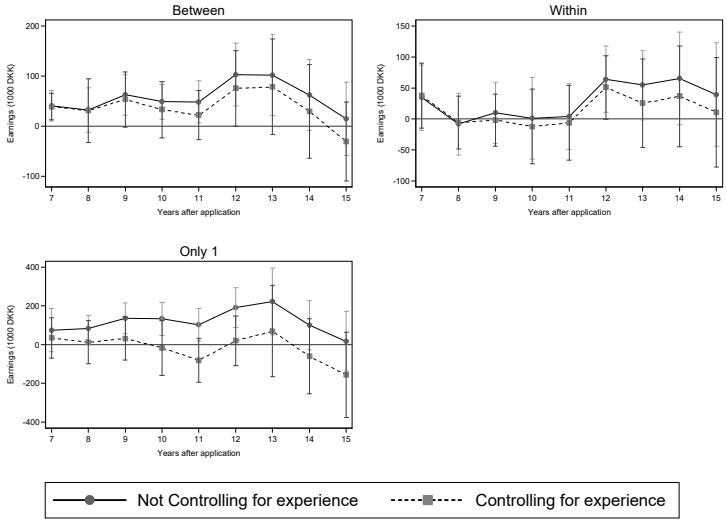


FIGURE V: ITT AND IV ESTIMATED PAYOFFS TO PREFERRED DEGREE OVER TIME (DKK YEAR)

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields.

TABLE IV: EFFECTS OF PREFERRED DEGREE ON PRESENT VALUE OF EARNINGS, BY APPLICANT TYPE

	(1) 0-6	(2) 7-10	(3) 11-15	(4) 0-10	(5) 0-15
Only One * 1(Application Score>Cutoff)	-48.36***	131.15***	53.21	87.53***	175.82**
	(9.97)	(22.88)	(40.44)	(27.77)	(84.53)
Within * 1(Application Score>Cutoff)	-5.54	-4.85	7.22	-8.64	50.19
	(19.57)	(32.84)	(49.29)	(46.83)	(95.24)
Between * 1(Application Score>Cutoff)	15.10	97.36***	126.24**	102.83**	282.01***
	(11.30)	(26.85)	(53.11)	(39.95)	(84.22)
Observations	38,868	31,852	12,924	28,690	11,107
Clusters	50	46	40	46	40

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables included in these regressions includes sex, a quadratic in age at application, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the application score and allow for different slopes on either side of zero. Preferred and second-best education indicators are also included. Standard errors, clustered at the six-digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

where j indexes applicant type *(Only One*, *Within* or *Between)* and k indexes broad field type (Humanities, Science, Social Science, Technology, Life Sciences, Medicine, Business, Law). It is important to note, as pointed out by Kirkeboen et al., the intention to treat parameters, e.g. βs, are informative for policy decisions, such as marginally expanding or contracting degree programs. If we estimate that one broad field has higher returns on average than another, this does not imply that this field has higher returns when compared against other particular fields. As Kirkeboen et al. discuss, the distribution of next-best fields is likely to be different between the two fields. Nonetheless, from a policy perspective the relevant counterfactual is the actual distribution of second-best fields.

Table V presents the results for one representative specification. To be clear, table presents the estimated β_{jk} where the columns of Table V show the values of j, the type of applicant, and the rows show the values of k, the broad fields. Turning first to the ITT effects for *Between* applicants shown in column 1, we see insignificant, and sometimes negative, effects on future earning from exceeding the GPA requirement if one's preferred broad field is Humanities, Science or Life Science. These effects are actually negative for both Humanities and Life Science. The effects of threshold crossing in all other broad fields are positive and significant, ranging from about 20 thousand DKK (about three thousand USD) in the case of those whose preferred field is Social Science to more than 50 thousand DKK (about eight thousand USD) for those whose preferred field is Law or Technology.

A similar pattern is seen for the *Only One* applicants except that the ITT effects for those applicants whose preferred field was Social Science is halved and insignificant and those whose preferred field was Life Science now realize positive and significant effects. Otherwise, the effects by broad field are generally larger for the *Only One* applicant group relative to the *Between* group, notably so for those applicants whose preferred field is Law: they receive a more than 75

TABLE V: EFFECTS OF PREFERRED DEGREE ON EARNINGS, BY BROAD FIELD

	(1)	(2)	(3)
	Between	Only One	Within
Humanities	-10.92	-11.01	-1.93
	(8.30)	(10.83)	(9.16)
Science	10.68	-16.86	-12.54
	(37.70)	(15.67)	(12.80)
Social Sciences	20.73**	9.06	5.79
	(9.01)	(12.88)	(10.51)
Technology	58.33***	50.44**	65.83**
	(11.38)	(18.97)	(27.03)
Life Sciences	-12.99	39.21***	-10.58
	(9.70)	(12.77)	(19.94)
Medicine	33.61***	42.77***	-25.05
	(8.22)	(12.45)	(17.13)
Business	33.29***	40.20***	
	(9.86)	(8.74)	
Law	56.27***	75.83***	
	(5.80)	(8.83)	
Observations		282,632	
Individuals		43.838	
Clusters		50	
Window		2,0	
Preferred and second-best education indicators		YES	
Control variables		YES	
Different slopes		YES	
Quadratic terms		NO	
Preferred and second-best institution indicators		NO	

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the function of the application score indicated in the table. Standard errors, clustered at the six-digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

thousand DKK benefit for threshold crossing. Finally, with exception to Technology, on average, no *Within* applicant realized significant positive gains on future earning from threshold crossing.

The takeaway from Table V is that the GPA requirements should be marginally lowered, though perhaps special consideration ought to be given to Science and Humanities. With exception to those whose broad field is Technology, these results also support the notion that it does not matter which field one is admitted within one's preferred broad field.

6.6 Comparative Advantage

In this section, we investigate the degree to which comparative advantage can explain our main result that individuals whose preferred and next-best fields lie within different broad fields generally obtain higher earnings, whereas applicants whose preferred and next-best fields lie within the same broad field generally do not. In other words, to what extent can our main results be explained by individuals preferring fields in which they have a comparative advantage? To try and answer this question, we follow Kirkeboen et al.[31]

Denoting β_{jk} as the return to crossing the GPA requirement of the preferred field j $(d_1 = j)$ when the individual's next-best field is k $(d_2 = k)$, we estimate the following regression:

$$(6) logy_{it} = \sum_{j,k\in B, j\neq k}\left[\beta_{jk}\mathbb{I}(r_i > 0) * \mathbb{I}(d_1 = j) * \mathbb{I}(d_2 = k)\right] +$$
$$\sum_{l,m\in W, l\neq m}[\beta_{lm}\mathbb{I}(r_i > 0) * \mathbb{I}(d_1 = l) * \mathbb{I}(d_2 = m)]$$
$$+\beta_O\mathbb{I}(r_i > 0) * \mathbb{I}(type = O) + f(r_i) + \alpha x_{it} + \varepsilon_{it}$$

[31] We perform this test for the OLS setting, not in the IV setting of Kirkeboen et al.

where the first summation has all the combinations of preferred and next-best broad fields (B is the set of *Between* applicants) and the second summation include all the combinations of preferred and next-best narrow fields within each broad field (W is the set of *Within* applicants). Because we do not decompose the effect of crossing the GPA threshold for applicants with only one preferred narrow field, we capture their effect by β_O. As in the main regressions, we include narrow field dummies for preferred and next-best fields, year dummies and dummies for year of admission, indicators if an applicant is a *Within* or *Between* applicant, as well as a few socioeconomic controls.

The starting point for Kirkeboen et al.'s analysis of comparative advantage is Sattinger's (1987, 1993) definition of comparative advantage: person 1 has comparative advantage over person 2 in field j, while person 2 has comparative advantage over person 1 in field k if the following inequality is true

(7)

$$\frac{y_1^j}{y_2^j} > \frac{y_1^k}{y_2^k} \Leftrightarrow \left(logy_1^j - logy_1^k\right) - \left(logy_2^j - logy_2^k\right) > 0$$

where y_i^j denotes the productivity – or in our case earnings – for individual i in field j. As shown by Kirkeboen et al. Figure VII, analogous to Figure XII in Kirkeboen et al., shows the distribution of the estimated relative differences $\mathrm{E}\left(logy^j - logy^k | d_1 = j, d_2 = k\right) - \mathrm{E}\left(logy^j - logy^k | d_1 = k, d_2 = j\right)$ weighted by the number of persons with the combinations of either field j preferred over field k or field k preferred over field j.

As we would expect from the main results of the paper, the distribution of pairwise sums of *Between* field estimates stochastically dominates the distribution of pairwise sums of *Within* field estimates. This result is intuitive as we would expect that comparative advantage would be smaller within a broad field than

across broad fields. Perhaps surprising is the fact that more mass lies below zero than above for *Within* applicants. In fact, as much as 95 percent of the pairwise sums of *Between* estimates are positive whereas this is only true for 44 percent of the pairwise sums of within estimates.

As in Kirkeboen et al., we conclude that *Between* field applicants tend to sort into fields in which they have a comparative advantage as the Roy model predicts. Compensating wage differentials can rationalize the remaining (relatively few) negative pairwise sums as discussed by Kirkeboen et al.

Furthermore, our results seem to rule out the case that individuals generally sort into narrow fields within a broad field based on comparative advantages. Of course, we cannot completely rule out sizable comparative advantage within broad fields, but at least individuals do not tend to sort on these advantages. We also cannot rule out that there may be comparative advantage within some selected combinations of narrow fields within particular broad fields, e.g. this appears to be the case within Technology (see Table V). Our result of less sorting within fields based on comparative advantage makes sense if programs within the same broad fields tend to reward similar skills.

Our finding that less than half of the pairwise sums of within estimates are positive suggests that there is not just a general long-lasting positive effect of being admitted to one's preferred field. Hence, based on the *Within* applicants, we do not seem to find evidence of a general positive effect due to enhanced passion and motivation (see Stoeber et al., 2011). If such a motivation effect is important and has implications that last beyond university study, we would expect to find positive earnings effects of being admitted in one's preferred degree for all applicants. As we only find significant positive earnings estimates for applicants whose next-best field lies in a different broad field, earnings effects are likely driven primarily by comparative advantage.

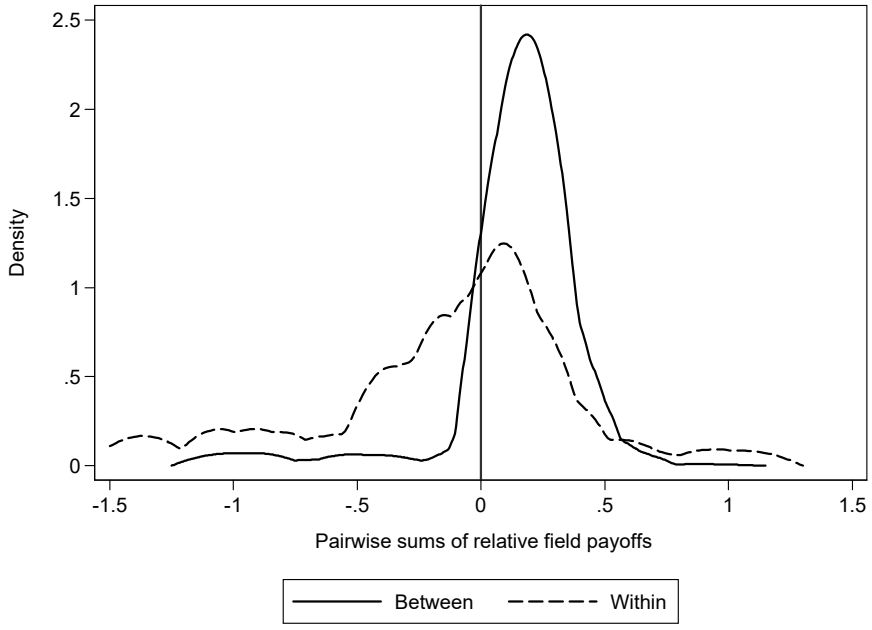


FIGURE VII: TESTABLE IMPLICATION **OF** SORTING BASED ON COMPARATIVE ADVANTAGE

6.7 *Results by sex*

Table IV presents the effects of surpassing the GPA admission requirement in one's preferred broad field broken out by the sex of the applicant. The same general patterns observed earlier are present for both sexes: male and female *Within* applicants realize no benefits from surpassing the GPA requirement of their preferred field, whereas *Between* and *Only One* applicants receive sizable and significant benefits for doing so. Among *Only One* applicants, women receive an added nine to eleven percent of their average annual earnings from exceeding the GPA cutoff required for admittance in their preferred degree while men receive an additional six to eleven percent. Among *Between* applicants, men benefit more from surpassing the GPA requirement necessary for admittance into

one's preferred degree: they realize a benefit from ten to fourteen percent of their average earnings opposed to women who only receive six to seven percent. Figure C3 in the appendix plots the estimate effects on earnings for each year after application, by sex. There is no substantial variation over time and the effects generally remain significant for the *Between* and *Only One* applicants.

6.8 Robustness Checks

In order to further examine the validity of our estimation strategy, we estimate the equivalent of equation (4)

(8) $$y_{it} = \sum_{j \in O,W,B} [\beta_j \, \mathbb{I}(\, r_i > p) * \mathbb{I}(\, type = j)] \; + f(\, r_i \,) + \alpha \, x_{it} + \varepsilon_{it}$$

separately for different values of p, the standardized GPA score above which an applicant has surpassed the admission criteria. If our estimation strategy is sound, we expect to see the largest effects when p is zero (the true value at which applicants are admitted) and that the effects die away as we look at pseudo cutoffs farther from zero. Figure VI plots the estimated effects resulting from estimating equation (6) for values of p between -0.5 and 0.5 for both the *Between* and *Only One* applicants. Reassuringly, we do indeed see this pattern.[32]

[32] *Within* coefficients are not shown as no significant effects were detected at $p = 0$.

TABLE IV: EFFECTS OF PREFERRED DEGREE ON EARNINGS, BY SEX

	(1)	(2)	(3)	(4)	(5)
(A) Women					
Only One * 1(Application Score>Cutoff)	24.84***	28.92***	26.31***	29.67***	29.96***
	(4.91)	(7.53)	(5.09)	(6.41)	(7.16)
Within * 1(Application Score>Cutoff)	-1.79	0.81	-1.24	4.40	3.06
	(8.61)	(8.83)	(8.04)	(8.09)	(12.20)
Between * 1(Application Score>Cutoff)	19.64**	19.94**	18.23**	16.10*	17.56**
	(7.81)	(8.87)	(7.22)	(8.80)	(7.42)
Observations	163,535	163,535	163,535	126,330	79,571
Individuals	25,280	25,280	25,280	19441	12149
Clusters	50	50	50	49	47
(B) Men					
Only One * 1(Application Score>Cutoff)	19.04***	36.07***	22.78***	30.62***	18.86**
	(5.57)	(8.77)	(5.85)	(7.30)	(8.35)
Within * 1(Application Score>Cutoff)	-1.86	14.46	1.69	9.95	-12.73
	(11.67)	(11.95)	(10.85)	(12.40)	(12.97)
Between * 1(Application Score>Cutoff)	36.21***	45.91***	33.00***	36.33**	34.34**
	(10.36)	(15.23)	(9.81)	(16.22)	(14.31)
Observations	119,097	119,097	119,097	88,749	53,975
Individuals	18,558	18,558	18,558	13755	8343
Clusters	50	50	50	50	49
Window	2,0	2,0	2,0	1,0	0,5
Preferred and second-best education indicators	YES	YES	YES	YES	YES
Control variables	NO	YES	YES	YES	YES
Different slopes	NO	YES	YES	YES	YES
Quadratic terms	NO	YES	NO	NO	NO
Preferred and second-best institution indicators	NO	YES	NO	NO	NO

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the function of the application score indicated in the table. Standard errors, clustered at the six-digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

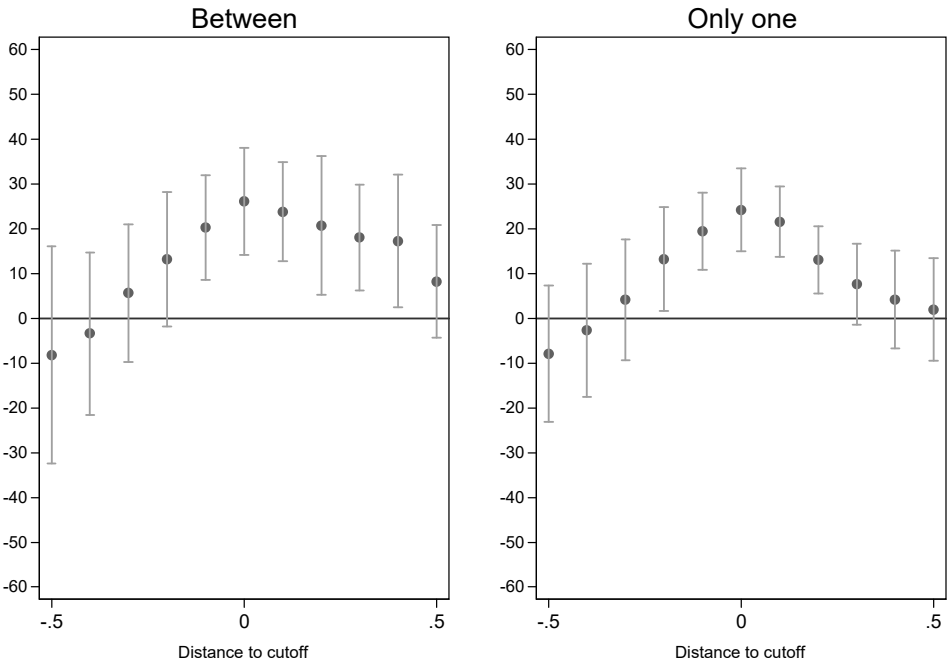


FIGURE VI: ESTIMATED PSEUDO EFFECTS OF PREFERRED DEGREE ON EARNINGS

7. Conclusion

In this paper, we have examined the effect of being admitted to one's preferred field of study on future earnings. Overall, we find that there is a potential for improving the allocation of students across fields by marginally lowering GPA admission requirements.

Lowering the GPA admission thresholds will allow more individuals who only apply for one field to start their studies immediately and consequently complete their studies earlier. We also find that lowering the admission threshold will permit individuals whose preferred and next-best fields are within different broad

fields to obtain higher labor market earnings due to a comparative advantage in their preferred field of study. However, we do not find that lowering the admission cutoff will increase earnings for individuals whose preferred and next-best fields are within the same broad field. We argue that these findings reflect that fields within the same broad discipline require similar skills. Consequently, comparative advantage within a broad field, on average, plays only a small role.

There are both practical and theoretical arguments for having at least some restrictions on intake. First, university departments may not have the necessary teaching resources and/or facilities for open admission. Second, policymakers may better forecast the demand for graduates across programs than the applicants would themselves. Third, in countries where university education is heavily subsidized, the goals of policymakers and applicants may not align. Applicants may place more importance on the nonpecuniary benefits of education, while the government, burdened with the task of financing the educational system through taxes, may emphasize economic returns. Regardless of the motivation behind imposing admission restrictions, our findings imply that a targeted marginal loosening of admission criteria would prove beneficial.

In addition to the policy recommendation of (at least) marginally lowering admission thresholds, the small role played by comparative advantage within a broad discipline suggests that prospective students ought to be encouraged to apply to multiple fields within the same broad field rather than just applying to a single narrow field within a particular discipline.

Furthermore, our finding that comparative advantage generally plays only a small role in fields within the same broad discipline leads to two additional interpretations. First, specialization within a broad field may not be necessary, at least at the start of an individual's university career. On the other hand, perhaps specialization *is* important, but the particular type of specialization an individual selects within a broad field holds less importance. Our results do not allow us to

discriminate between these two possible interpretations. To the extent that the former interpretation holds true, reducing the number of narrow programs and operating with fewer bachelor's degree programs within a broad field of study may prove cost-effective.

Acknowledgements

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Appendix A: Data

TABLE A1: BASIC CLEANING

	Drop	Individual-Application Year-Preferences	Individual-Application Years	Individuals
1	Raw, 1993-2006	1,776,163	857,297	592,272
2	Drop observation with empty/numeric pnr	1,690,091	823,069	561,153
3	Drop observations with KOT priority errors	1,667,904	814,447	555,833
4	Drop those who can't be matched to education registries (educ spells)	1,653,365	806,760	548,937
5	Drop years before 1996 (after flagging first year applied)	1,247,414	626,346	442,624
6	Drop individuals not on Fainv	1,245,366	625,498	441,898
7	Keep those whose age at application is between the ages of 17 and 25	1,004,869	487,973	347,999
8	Drop folks who do not appear on BEF (which goes from 2008-2013)	1,004,471	487,788	347,839
9	Drop immigrants (ie_type==2)	932,676	459,164	326,682
10	Keep first time applicants	603,215	302,672	302,672
11	Drop individuals with no HS GPA	522,310	259,152	259,152
12	Drop those had a KOT application year before graduation year	497,978	246,739	246,739

TABLE A2: SAMPLE SELECTION

A	B	C	D	E	F	G
	Drop	**Observation Type in column D**	**Observations**	**Individual**	**Individuals with Multiple Preferences**	**Individuals with Only One Preference**
	After Basic Cleaning	**Individual-Raw Preferences**	**497,978**	**246,739**	**130,024**	**116,715**
1	Dropping those who only have preferences for KOT>=30000 or other fields that we don't consider	Individual-Raw Preferences	270,097	126,758	71,018	55,740
2	Aggregating at the 6 Digit level	Individual-Aggregated Preferences	221,752	126,758	57,273	69,485
3	Dropping those with a non-binding cut-off in most preferred broad field	Individual-Aggregated Preferences	169,209	91,762	45,883	45,879
	Drops made on those with multiple preferences					
4a	Dropping those who are most interested in High KOT before (i.e. before preferred and next-best)	--	--	--	33,177	--
4b	Dropping those whose next-best field is for a program we are not interest in (High KOT)	--	--	--	24,937	--
4c	Drop people whose GPA never exceed a threshold or who have local priorities for HIGH KOT	--	--	--	19,908	--
4d	Drops individuals whose preferred and next-best have non-descending GPA cutoffs	--	--	--	15,129	--
4e	Again need to drop those who have a high KOT preference before their preferred and next bet. Above we did this for KOTS that appeared before ANY other GPA in the preference ranking. But we need to drop folks for instance who have low KOT preferences, followed by high KOT preferences, followed by their preferred and next-best	--	--	--	15,079	--

4f	For those who have preferred field of 3 and next-best of 4, we need that the GPA cutoffs of 1&2 be higher than the cutoff of 3 and 4, but we don't care if 1 is less than 2	--	--	--	14,226	--
	Drops made to those with just one preference					
5	Dropping those who have a non-binding cutoff or only apply for high KOT	--	--	--	--	41,644
6	Bringing sample together after drops 4 & 5	Individual-Aggregated Preferences	80,079	55,870	14,226	41,644
7	Dropping preferences other than preferred and next-best. Bringing together those with one preference (one record per individual) and those with multiple preference (2 records per individual)	Individual-Aggregated Preferences	70,096	55,870	14,226	41,644
8	Dropping those whose educations could not be found on educ6d_onlyBA (line 873 of 03_Creating_estimation_Data)	Individual-Aggregated Preferences	66,129	52,968	13,161	39,807
9	Horizontal wrt aggregated preferences	Individuals	52,968	52,968	13,161	39,807
10	Merge to all years in Demographic /Income Files	Individual-Earnings Years	894,345	52,968	13,161	39,807
11	Drop observations that are less than 7 years after KOT application	Individual-Earnings Years	334,571	52,323	13,000	39,323
12	Drop individuals if educBA1 or educBA2 <600000	Individual-Earnings Years	330,559	51,576	12,726	38,850
13	Drop if individual has max grad time less than 4 years	Individual-Earnings Years	321,882	49,887	12,374	37,513
14	Dropping negative earnings observations and those earnings above the 99.75 percentile)	Individual-Earnings Years	321,108	49,871	12,368	37,503
16	Dropping those whose standardized GPA greater than 2 in absolute value	Individual-Earnings Years	303,591	47,033	11,955	35,078
15	Dropping those whose GPA is equal to the cutoff- **Estimation Sample**	Individual-Earnings Years	282,632	43,838	10,870	32,968

TABLE A3: FURTHER SAMPLE SELECTION FOR IV SAMPLE

A	B	C	D	E	F	G
	Drop	**Observation Type in column D**	**Observations**	**Individual**	**Individuals with Multiple Preferences**	**Individuals with Only One Preference**
13	Drop if individual has max grad time less than 4 years (Same from prior table)	Individual-Earnings Years	321,882	49,887	12,374	37,513
14 IV	Drop individuals that haven't completed a selected masters (line 1465)	Individual-Earnings Years	225,268	33,407	8,249	25,158
15IV	Drop observations that occur before max graduation date	Individual-Earnings Years	173,597	33,404	8,248	25,156
16IV	Dropping negative earnings observations and those earnings above the 99.75 percentile)	Individual-Earnings Years	172,934	33,392	8,244	25,148
17IV	Dropping those whose standardized GPA greater than 2 in absolute value	Individual-Earnings Years	164,414	31,627	8,019	23,608
18IV	Dropping those whose GPA is equal to the cutoff- **Estimation Sample**	Individual-Earnings Years	152,866	29,464	7,269	22,195

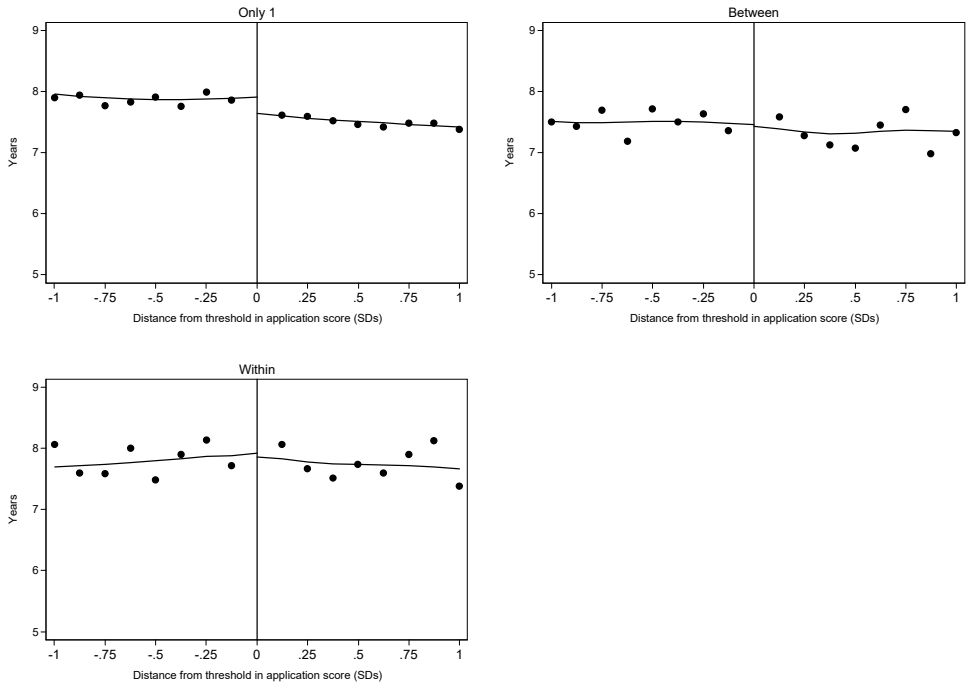


FIGURE A3: ADMISSION THRESHOLDS AND TIME TO GRADUATION (BW1)

Only One refers to applicants who applied for one study program. `Between' refers to applicants whose preferred and next-best fields are in different broad fields. `Within' refers to those applicants whose preferred and second-best fields are within the same broad fields.

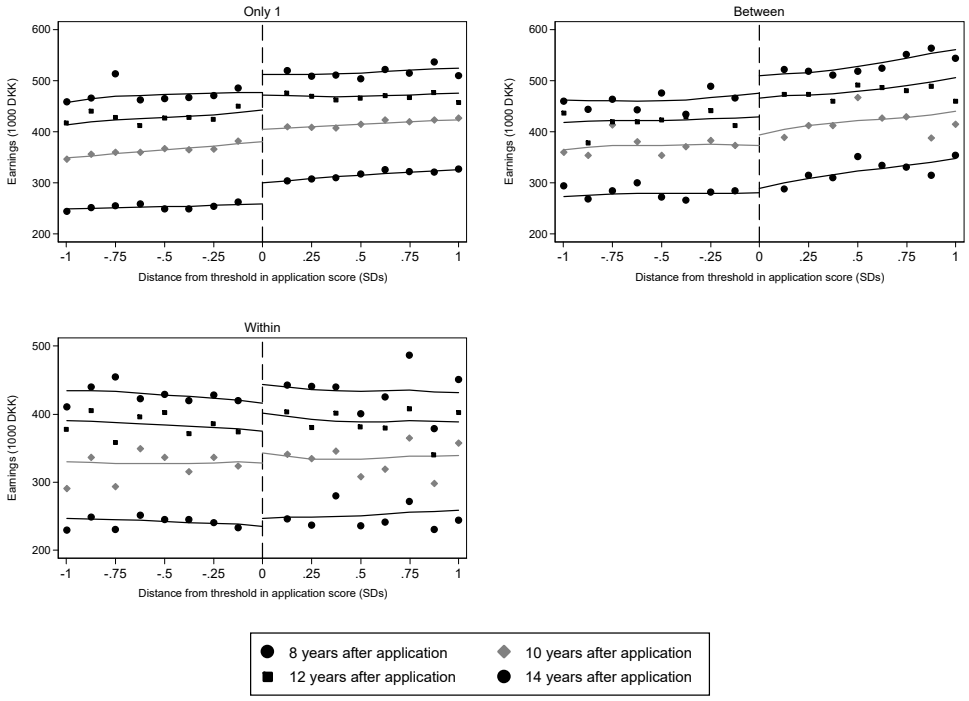


FIGURE A4: AVERAGE EARNINGS AROUND ADMISSION CUTOFFS

Only One refers to applicants who applied for one study program. `Between' refers to applicants whose preferred and next-best fields are in different broad fields. `Within' refers to those applicants whose preferred and second-best fields are within the same broad fields.

Appendix B : Admission Thresholds by various covariates (BW1)

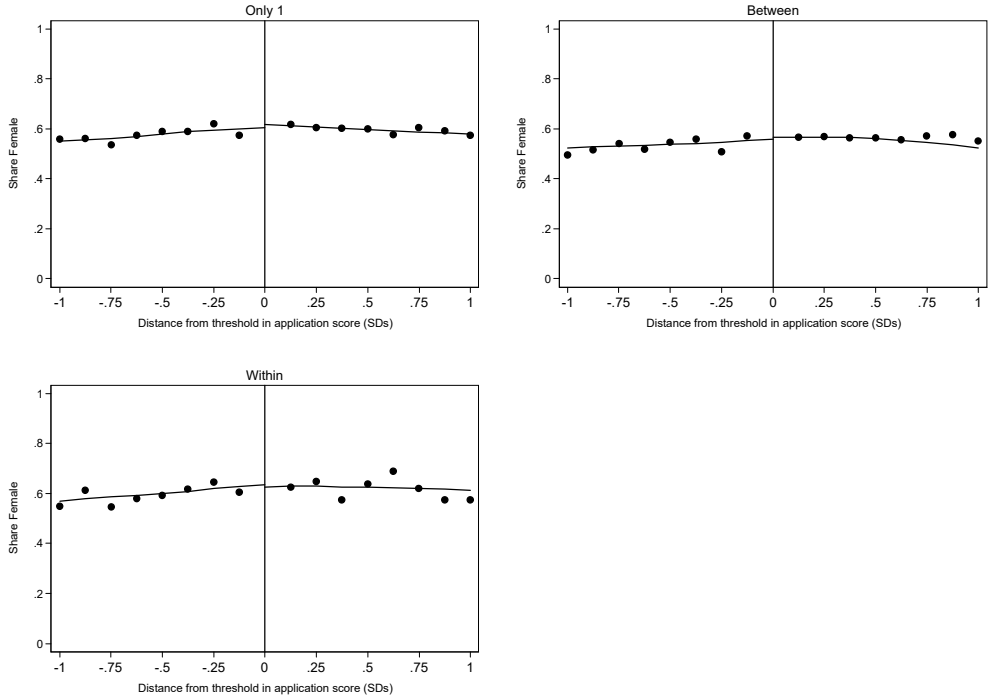


FIGURE B1: ADMISSION THRESHOLDS BY SEX

Only One refers to applicants who applied for one study program. `Between' refers to applicants whose preferred and next-best fields are in different broad fields. `Within' refers to those applicants whose preferred and second-best fields are within the same broad fields.

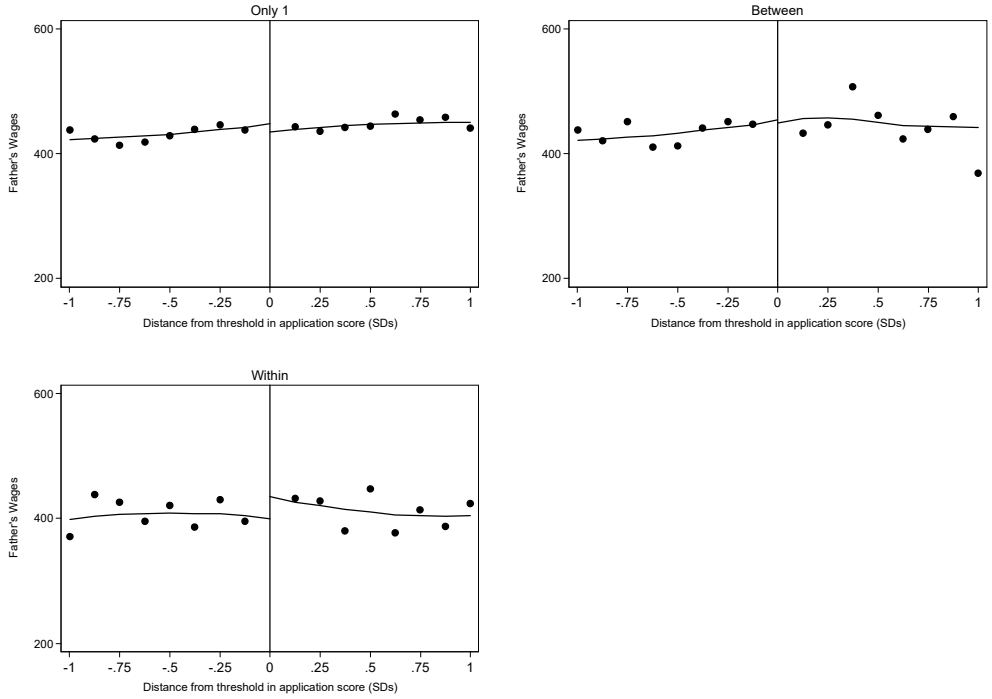


FIGURE B3: ADMISSION THRESHOLDS BY EARNINGS OF FATHER

Appendix C: Additional Results

TABLE C1: MULTIPLE SPECIFICATIONS

	(1)	(2)	(3)	(4)	(5)
(A)					
1(Application Score > Cutoff)	19.00***	21.36***	21.73***	29.71***	29.72***
	(4.26)	(3.76)	(3.64)	(4.63)	(4.61)
Observations	282,632	282,632	282,632	282,632	282,632
Individuals	43838	43838	43838	43838	43838
Clusters	50	50	50	50	50
(B)					
Only One * 1(Application Score>Cutoff)	21.10***	24.07***	24.34***	32.51***	32.70***
	(4.80)	(4.68)	(4.57)	(4.82)	(4.79)
Within * 1(Application Score>Cutoff)	-2.45	-0.51	-0.08	8.15	7.74
	(7.92)	(7.59)	(7.12)	(7.18)	(7.39)
Between * 1(Application Score>Cutoff)	25.59***	25.82***	26.21***	34.64***	34.12***
	(7.22)	(6.06)	(6.28)	(8.10)	(8.09)
Observations	282,632	282,310	282,310	282,310	282,310
Individuals	43838	43838	43838	43838	43838
Clusters	50	50	50	50	50
Preferred and second-best education indicators	YES	YES	YES	YES	YES
Control variables	NO	YES	YES	YES	YES
Different slopes	NO	NO	YES	YES	YES
Quadratic terms	NO	NO	NO	YES	YES
Preferred and second-best institution indicators	NO	NO	NO	NO	YES

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the function of the application score indicated in the table. Standard errors, clustered at the six-digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

TABLE C2: MULTIPLE SPECIFICATIONS

	(1)	(2)	(3)	(4)	(5)
Between * 1(Application Score>Cutoff)*					
Humanities	-11.76	-11.17	-10.92	-1.85	-1.99
	(10.94)	(8.81)	(8.30)	(9.39)	(9.22)
Science	7.99	10.49	10.68	19.61	12.40
	(39.55)	(37.86)	(37.70)	(37.84)	(38.70)
Social Sciences	20.00*	20.48**	20.73**	29.88***	29.32***
	(10.21)	(8.93)	(9.01)	(10.44)	(9.91)
Business	18.01	33.03***	33.29***	42.78***	44.87***
	(12.48)	(10.34)	(9.86)	(11.43)	(11.41)
Law	48.63***	56.12***	56.27***	65.20***	64.80***
	(5.52)	(6.04)	(5.80)	(7.51)	(7.54)
Technology	69.67***	58.33***	58.33***	67.89***	66.99***
	(13.83)	(11.39)	(11.38)	(12.01)	(12.61)
Life Sciences	-3.52	-13.53	-12.99	-3.55	-4.29
	(12.28)	(9.79)	(9.70)	(11.46)	(11.79)
Medicine	46.31***	33.35***	33.61***	42.90***	42.97***
	(7.72)	(8.33)	(8.22)	(9.07)	(9.11)
Within * 1(Application Score>Cutoff)*					
Humanities	-3.41	-2.12	-1.93	7.08	5.90
	(10.04)	(9.39)	(9.16)	(9.44)	(9.45)
Science	-17.27	-12.98	-12.54	-3.59	-2.36
	(14.92)	(13.14)	(12.80)	(12.25)	(12.28)
Social Sciences	-5.16	5.41	5.79	14.70	14.80
	(12.91)	(11.28)	(10.51)	(10.80)	(11.43)
Technology	87.82***	65.69**	65.83**	75.01***	68.47**
	(28.65)	(27.08)	(27.03)	(26.43)	(26.73)
Life Sciences	4.55	-11.38	-10.58	-1.46	2.62
	(16.51)	(19.51)	(19.94)	(19.50)	(17.57)
Medicine	-2.57	-25.14	-25.05	-16.54	-15.07
	(21.76)	(17.28)	(17.13)	(17.04)	(17.76)
Only One * 1(Application Score>Cutoff)					
Humanities	-17.38	-11.14	-11.01	-2.18	-2.51
	(11.80)	(11.08)	(10.83)	(10.55)	(10.54)
Science	-14.40	-17.09	-16.86	-8.08	-8.19
	(21.14)	(16.10)	(15.67)	(15.11)	(14.88)
Social Sciences	-3.06	8.79	9.06	17.90	17.50
	(13.70)	(13.07)	(12.88)	(12.98)	(12.76)
Business	32.92***	40.11***	40.20***	49.41***	54.96***
	(10.08)	(8.93)	(8.74)	(7.97)	(7.96)
Law	74.78***	75.77***	75.83***	84.55***	84.02***
	(9.82)	(8.97)	(8.83)	(7.88)	(7.66)
Technology	60.75**	50.52**	50.44**	59.78***	60.60***

	(24.76)	(18.88)	(18.97)	(18.45)	(18.28)
Life Sciences	36.03**	38.71***	39.21***	48.50***	49.50***
	(16.18)	(13.11)	(12.77)	(12.34)	(11.90)
Medicine	47.47***	42.55***	42.77***	51.80***	51.36***
	(13.50)	(12.54)	(12.45)	(11.96)	(11.87)
Observations	282,632	282,632	282,632	282,632	282,632
Preferred and second-best education indicators	YES	YES	YES	YES	YES
Control variables	NO	YES	YES	YES	YES
Different slopes	NO	NO	YES	YES	YES
Quadratic terms	NO	NO	NO	YES	YES
Preferred and second-best institution indicators	NO	NO	NO	NO	YES
Clusters	50	50	50	50	50

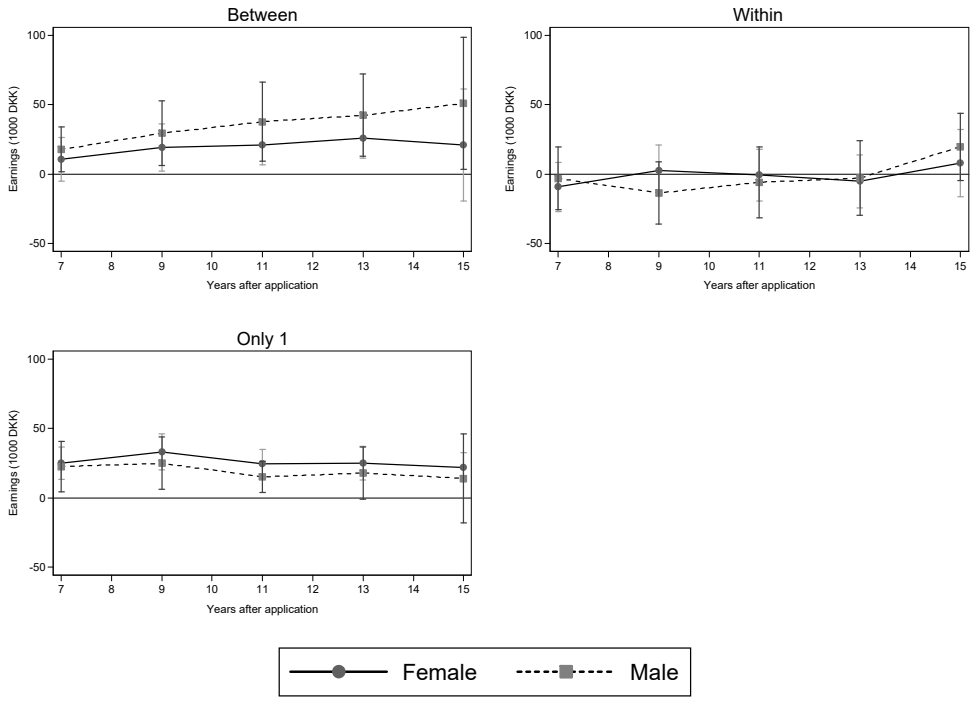


FIGURE C1: ESTIMATED PAYOFFS TO PREFERRED DEGREE OVER TIME (DKK YEAR), BY GENDER

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields.

TABLE C3: STANDARD ERRORS CLUSTERED ON THE RUNNING VARIABLE

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Only One * 1(Application Score>Cutoff)	21.10***	24.07***	24.34***	32.51***	32.70***
	(3.32)	(2.98)	(3.10)	(5.88)	(5.72)
Within * 1(Application Score>Cutoff)	-2.45	-0.51	-0.08	8.15	7.74
	(6.76)	(5.32)	(5.58)	(8.07)	(7.90)
Between * 1(Application Score>Cutoff)	25.59***	25.82***	26.21***	34.64***	34.12***
	(4.76)	(4.82)	(4.75)	(6.54)	(6.48)
Observations	282,632	282,632	282,632	282,632	282,632
Individuals	43838	43838	43838	43838	43838
Clusters	32	32	32	32	32
Preferred and second-best education indicators	YES	YES	YES	YES	YES
Control variables	NO	YES	YES	YES	YES
Different slopes	NO	NO	YES	YES	YES
Quadratic terms	NO	NO	NO	YES	YES
Preferred and second-best institution indicators	NO	NO	NO	NO	YES

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the function of the application score indicated in the table. Standard errors, clustered on the running variable, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Online Appendix

Additional Descriptive Information on Main Sample used for ITT

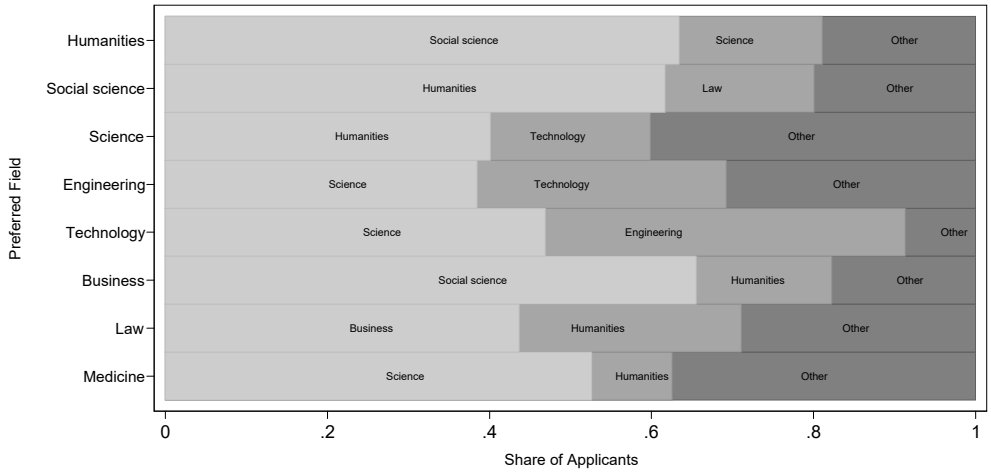


FIGURE O1: MOST COMMON NEXT-BEST FIELDS BY PREFERRED FIELDS FOR BETWEEN APPLICANTS

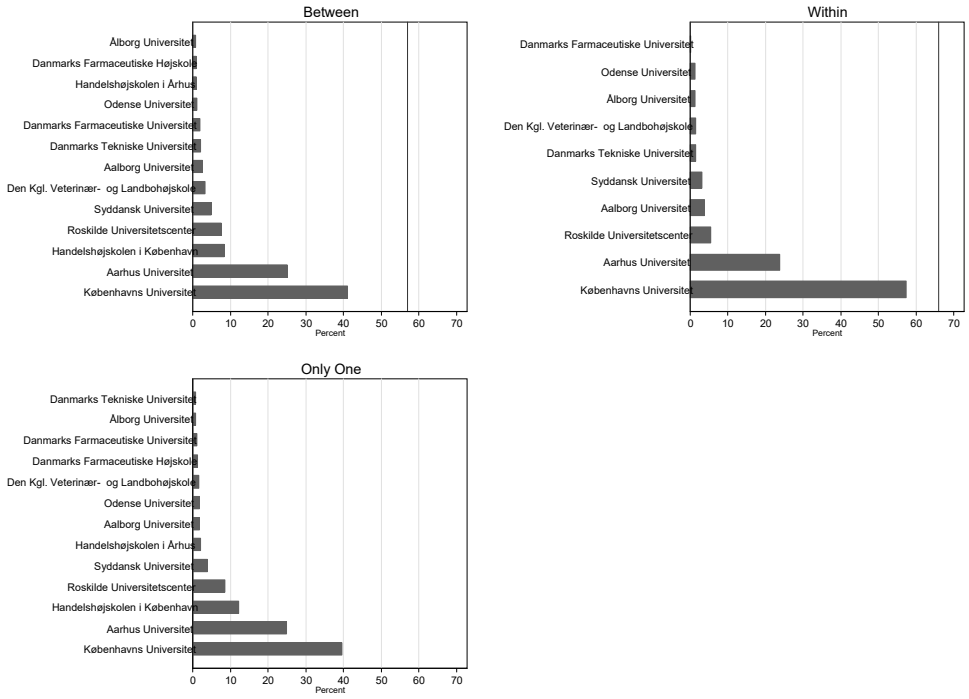


FIGURE O2: MOST PREFERREDINSITITUTIONS BY TYPE

Only One refers to applicants who applied for one study program. `Between' refers to applicants whose preferred and next-best fields are in different broad fields. `Within' refers to those applicants whose preferred and second-best fields are within the same broad fields.

Description of sample used for IV estimation

TABLE O1: SUMMARY STATISTICS

	Estimation Sample								Full Sample	
	Only One		Between		Within		All		First Time Applicants who completed an MA	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Age at application	19.66	(1.32)	19.77	(1.27)	19.95	(1.31)	19.71	(1.32)	19.75	(1.31)
Female	0.59		0.56		0.61		0.59		0.55	
Earnings 8 years after application	413.35	(174.60)	409.42	(161.74)	348.81	(163.38)	406.74	(172.57)	308.92	(205.51)
Application Score	0.03	(1.01)	-0.11	(0.97)	-0.09	(0.98)	0.00	(1.00)	-0.21	(1.12)
Mother has higher education	0.53		0.54		0.54		0.53		0.51	
Father has higher education	0.51		0.53		0.51		0.52		0.48	
Father's earnings (1000DKK)	318.97	(287.26)	324.42	(280.45)	293.01	(233.11)	317.23	(281.50)	320.6	(257.46)
Fields ranked	1.00	(0.00)	2.54	(0.86)	2.58	(0.90)	1.38	(0.80)	1.63	(0.95)
Institutions ranked	1.22	(0.53)	1.82	(0.88)	1.77	(0.89)	1.36	(0.68)	1.48	(0.76)
Rank of best offer	1.04	(0.22)	1.57	(0.85)	1.59	(0.81)	1.20	(0.54)	1.18	(0.57)
Offered first priority	0.72		0.55		0.51		0.68		0.75	
Offered second priority	0.03		0.28		0.31		0.09		0.08	
Offered third priority	0.00		0.06		0.07		0.02		0.02	
No offer	0.25		0.08		0.08		0.20		0.14	
Individuals	22195		4378		2891		29464		71710	

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. About 3% and 6% of mother and father education is missing, respectively. About 5% of father's earnings is missing. Monetary figures shown in 1000s 2015 DKK. The full sample first time applicants samples corresponds to the sample after basic cleaning and after individuals with preferences only for non-university education have been dropped. (Drop 1 from Appendix Table AII). The full sample who completed an MA is the subsample that also completed a selected MA. Earnings maybe missing in a given year if drops 15IV (Drop observations that occur before max graduation date) or 16IV apply (drop negative or very high earnings) in Appendix Table AV, or if they are not in the register that year. About 40% of observations don't have earnings in the 8th year after application in the estimation sample as opposed to 12% in the full sample completed MA.

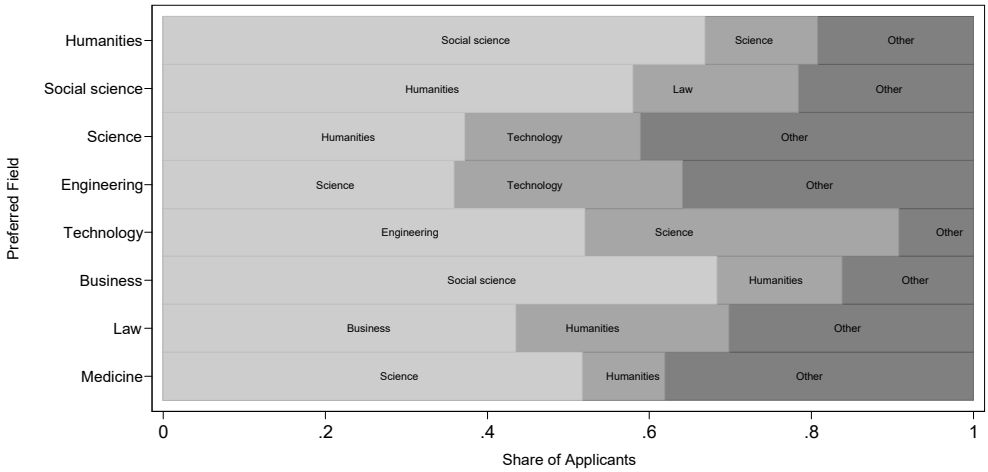


FIGURE O1:

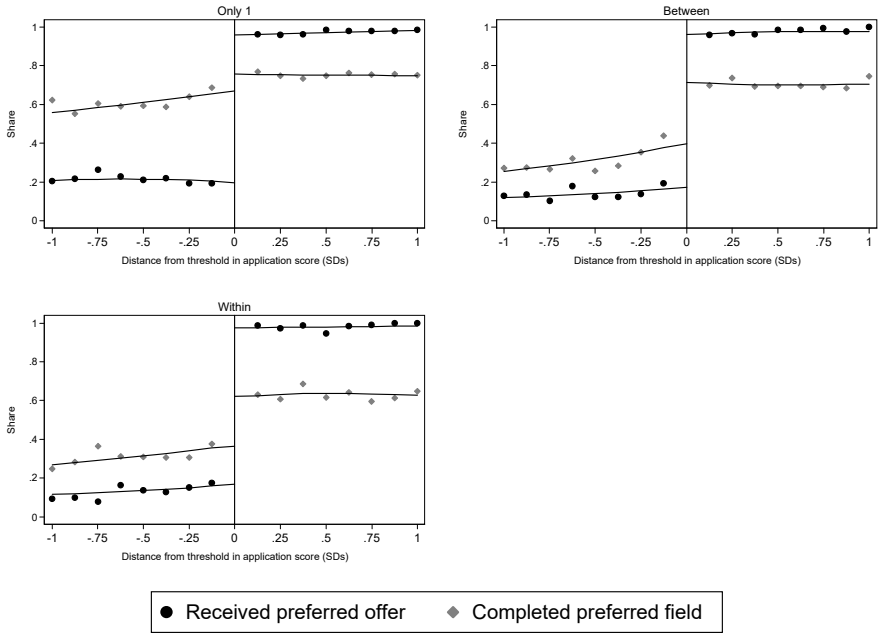


FIGURE O2: ADMISSION THRESHOLDS AND PREFERRED FIELD OFFER AND COMPLETION (BW 1.5)

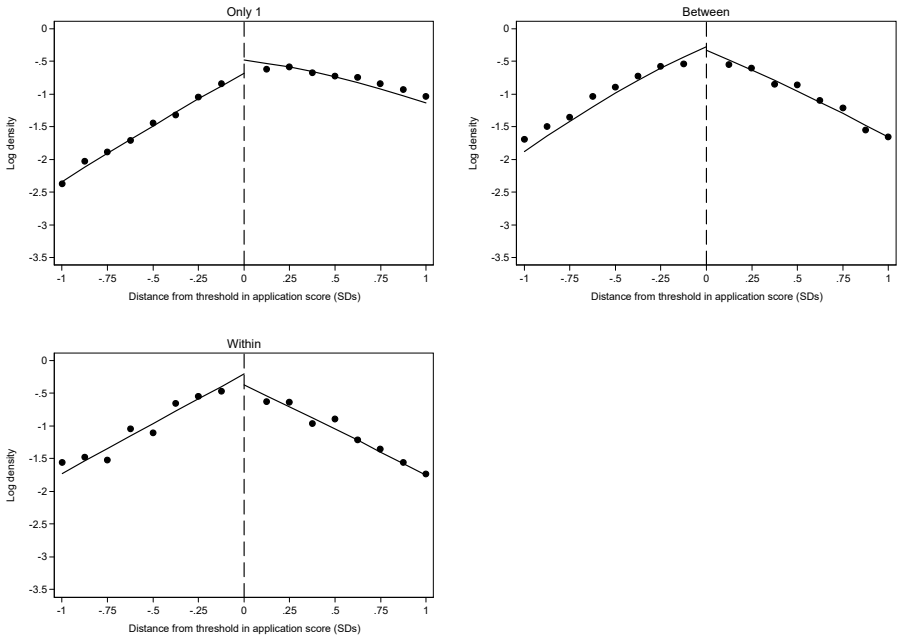


FIGURE O3: BUNCHING CHECK AROUND THE ADMISSIONS CUTOFFS

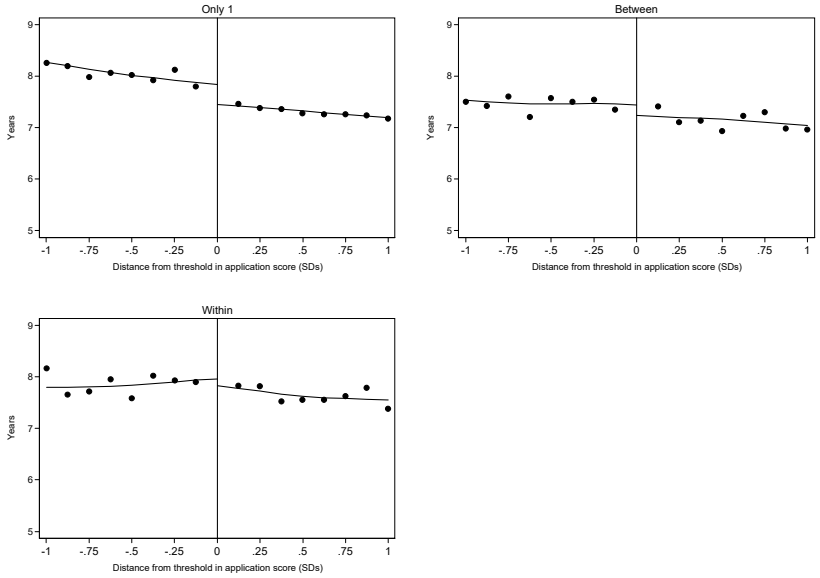


FIGURE O4: ADMISSION THRESHOLDS AND TIME TO GRADUATION (BW1.5)

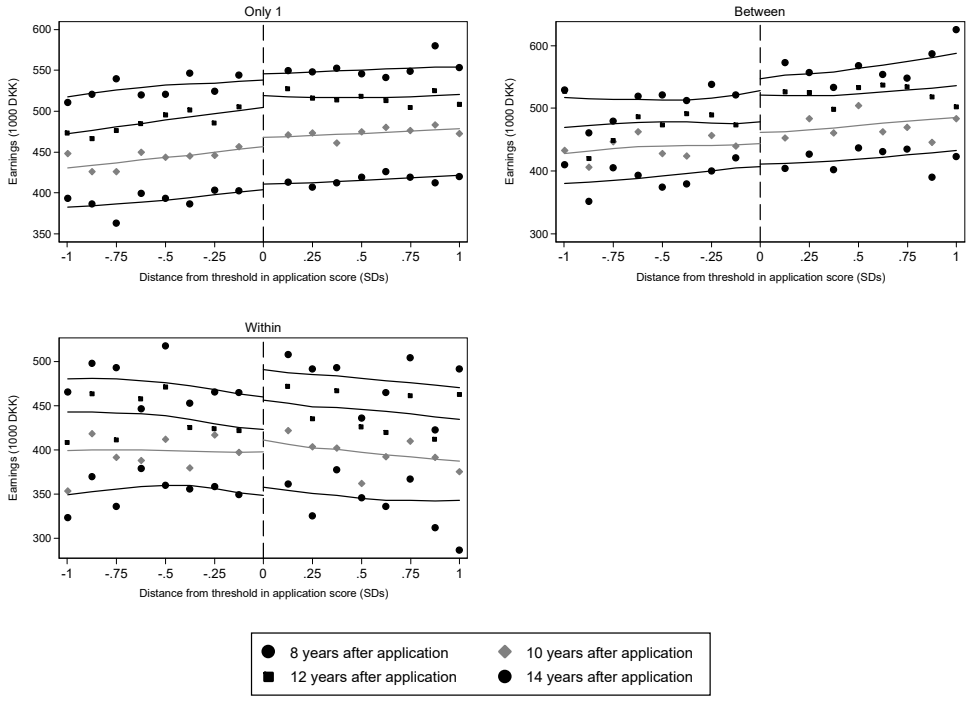
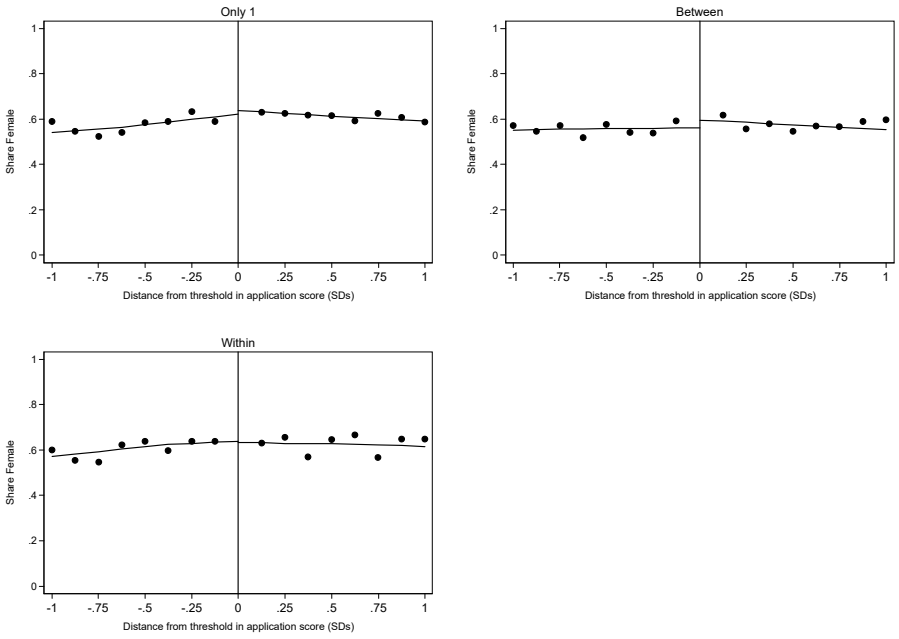


FIGURE O5: AVERAGE EARNINGS AROUND ADMISSION CUTOFFS (BW1.5)



FIGUREO6: NEW ADMISSION THRESHOLDS BY SEX

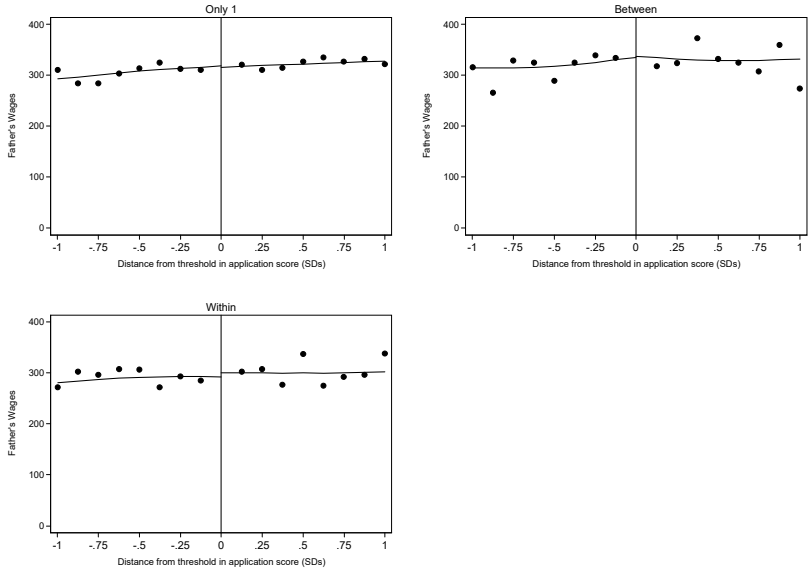


FIGURE O7: ADMISSION THRESHOLDS BY EARNINGS OF FATHER

TABLE O2: MAIN RESULTS DROPPING VARIOUS FIELDS

	(1) Baseline	(2) No Humanities	(3) No Law and No Business
Only One * 1(Application Score>Cutoff)	21.10***	31.87***	21.69***
	(4.80)	(4.44)	(5.50)
Within * 1(Application Score>Cutoff)	-2.45	2.03	7.82
	(7.92)	(10.90)	(7.71)
Between * 1(Application Score>Cutoff)	25.59***	28.50***	18.38***
	(7.22)	(7.83)	(6.34)
Observations	282,632	217,709	235,249
Preferred and second-best education indicators	YES	YES	YES
Control variables	YES	YES	YES
Different slopes	YES	YES	YES
Quadratic terms	YES	YES	YES
Preferred and second-best institution indicators	YES	YES	YES
Clusters	50	28	48

Only One refers to applicants who applied for one study program. Between refers to applicants whose preferred and next-best fields are in different broad fields. Within refers to those applicants whose preferred and second-best fields are within the same broad fields. The set of control variables includes sex, a quadratic in age, father's earnings at applicant age 16, an indicator for whether father's earnings are missing, calendar year indicators, indicators for year of application, and indicators for *Within* and *Between* type. All regressions include the function of the application score indicated in the table. Standard errors, clustered at the six-digit education level, shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1