O Brother, Where Start Thou?
Sibling Spillovers on College and Major Choice in Four Countries†

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Abstract

Family and social networks are widely believed to influence important life decisions but causal identification of those effects is notoriously challenging. Using data from Chile, Croatia, Sweden, and the United States, we study within-family spillovers in college and major choice across a variety of national contexts. Exploiting college-specific admissions thresholds that directly affect older but not younger siblings' college options, we show that in all four countries a meaningful portion of younger siblings follow their older sibling to the same college or college-major combination. Older siblings are followed regardless of whether their target and counterfactual options have large, small or even negative differences in quality. Spillover effects disappear, however, if the older sibling drops out of college, suggesting that older siblings' college experiences matter. That siblings influence important human capital investment decisions across such varied contexts suggests that our findings are not an artifact of particular institutional detail but instead a more generalizable description of human behavior. Causal links between the postsecondary paths of close peers may partly explain persistent college enrollment inequalities between social groups and suggests that interventions to improve college access may have multiplier effects.

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JEL codes: I21, I24.

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1 Introduction

The decisions of whether to go to college, where to enroll and what to specialize in are among the most consequential an individual will make in their life. Each of these choices can significantly impact a host of important outcomes including future earnings and other broad life outcomes, and in the aggregate can drive economic growth and inequality (Goldin and Katz, 2008).[1] Despite the significance of these choices, we know very little about their determinants. Social context and family background seem to play an important role in shaping higher education trajectories, which suggests that close peers and relatives could significantly influence decisions regarding post-secondary education (Hoxby and Avery, 2013; Chetty et al., 2020). However, causally identifying the influence of family and social networks on human capital investment is challenging, and evidence on how close peers affect crucial post-secondary decisions is still scarce.

This paper provides causal evidence that older siblings—one of the most relevant members of an individual's social network—influence the college and major choices of younger siblings. Using data from Chile, Croatia, Sweden and the United States, we show that shocks to older siblings' higher education trajectories impact younger siblings' application and enrollment decisions in meaningful ways. That we consistently observe such patterns across these different settings suggests our findings are not simply artifacts of a specific national context.

We overcome the challenges of causally identifying peer effects—i.e., correlated effects and the reflection problem—by exploiting admission cutoffs that generate quasi-random variation in the college or college-major in which older siblings enroll. In each country, we use rich administrative data that allow us to identify siblings and to link them to detailed data on college applications and enrollment decisions. We thus use a regression discontinuity design to compare college and major choices of younger siblings whose otherwise identical older siblings were just above or below these

[1] Labor economists have accumulated extensive evidence on the causal effects of education on earnings and other life outcomes. The evidence on the returns to education is reviewed in Card (1999) and Card (2001). Altonji, Blom, and Meghir (2012) documents the heterogeneity in earnings across college and majors. Altonji, Arcidiacono, and Maurel (2016) reviews the literature on the returns to college and majors, emphasizing heterogeneity in the effects of education. Hastings, Neilson, and Zimmerman (2013) and Kirkebøen, Leuven, and Mogstad (2016) show causal evidence that specific college-major combinations, as well as broader fields of study, significantly impact earnings in the short and longer term. Heckman, Humphries, and Veramendi (2018) emphasizes heterogeneity in these returns and finds impacts on a broader set of outcomes such as smoking and health. It should be noted that differences in costs, both in resources and time, make post-secondary human capital investment decisions very important even in the absence of differential earnings outcomes.

admission cutoffs.

These cutoffs have somewhat different origins across the four countries. As in many countries, universities in Chile, Sweden and Croatia coordinate admissions through a centralized application system that provides students with a single admission offer. These systems allocate applicants to a unique college-major combination based on their academic performance and on a ranked ordered list of college-major preferences that they submit when applying. The single admission offer system generates sharp cutoffs at all oversubscribed programs. This application data also allows us to identify the next best alternative the applicant would have been assigned to had they not been accepted at their assigned college-major program. We use this data to identify the counterfactual educational trajectory as in Kirkebøen, Leuven, and Mogstad (2016). In the U.S., admission decisions are decentralized so that students may receive offers from multiple colleges. We use data on the universe of SAT-takers and their enrollment choices to identify a subset of colleges that use SAT score cutoffs in their admission process.

In all four countries, we find causal evidence that younger siblings systematically follow their older siblings to the same college. Younger siblings are between 7 pp and 27 pp more likely to apply, and between 4 pp and 17 pp more likely to enroll in their older sibling's college. In Chile, Croatia and Sweden, where students are admitted to a specific major within a college, younger siblings also follow their older siblings to the same college-major combination. The absolute magnitude of the spillovers in this case is smaller than in the case of the choice of college, but the effects are large relative to baseline levels. In the U.S., we present evidence that older siblings affect the extensive margin —an older sibling's enrollment in a four-year college increases the younger sibling's probability of also enrolling in a four-year college by 23 pp.

Sibling spillovers on college application and enrollment decisions can shift younger siblings' decisions in relevant ways. In the U.S., older siblings induce younger siblings to enroll in four-year colleges. This results in younger siblings attending colleges with higher B.A. completion rates and peer quality. The effects that we find in the U.S. are driven largely by students we label as "uncertain college-goers", those from families whose demographic and economic characteristics predict lower four-year college enrollment rates. These changes in the college choices of younger siblings likely have important economic effects, given recent evidence on the returns to four-year college for marginal students (Zimmerman, 2014; Goodman, Hurwitz, and Smith, 2017) and heterogeneity in value-added across colleges (Dillon and Smith, 2019; Chetty et al., 2020).

In Chile, Croatia, and Sweden, our ability to observe the next best alternative college option lets us learn even more. Characterizing programs by average earnings for graduates, peer quality and retention rates, we find that older siblings are followed both when the difference between the target program and the next best alternative is large and when it is small. Younger siblings follow their older siblings to the same college and college-major combination even when the target program has lower expected earnings, peer quality and retention rates. If, however, the older sibling drops out of college, this eliminates any spillover effect, suggesting that older siblings' experiences in college matter.

We discuss three broad classes of mechanisms that could explain why older siblings influence the higher education trajectories of their younger siblings. First, an older sibling's educational trajectory could affect the costs of the option. For example, siblings could commute together or could share housing costs. Second, older siblings' choices could affect the utility that younger siblings derive from particular colleges and majors by changing their preferences. Third, an older sibling could affect the options younger siblings are considering, either by improving the chances of being admitted or by making them aware of new options and their characteristics. To explore these potential mechanisms, we leverage institutional differences across countries, our rich data, and heterogeneity analyses. We present evidence likely ruling out that the observed sibling spillovers are driven by a change in costs or in admissions probabilities. We cannot, however, perfectly distinguish between whether older siblings change their younger siblings' preferences or their awareness of specific options and their characteristics.

Our results contribute to two major strands of research. First, we provide some of the only evidence of peer effects in college and major choices. Until recently, most of the voluminous peer effects literature exploited random or quasi-random assignment of classmates, schoolmates or roommates to study spillovers of peers' characteristics or risky behaviors onto students' own academic achievement or risky behaviors (Sacerdote, 2011). That literature rarely, if ever, focused on siblings as peers or considered college choices as either treatments or outcomes. Recent research has begun to provide evidence of spillovers between siblings in various behaviors, including: smoking and drinking (Altonji et al., 2017); military service (Bingley et al., 2019); and paternity leave usage (Dahl et al., 2014). The latter two papers argue that increased information, about the returns to military service and employers' reaction to leave-taking, are the most likely mechanism explaining sibling spillovers in these non-educational choices.

A handful of recent papers, largely from outside the US, suggest sibling spillovers in educational choices, often in secondary school.[2] Using distance to the nearest girls' school as an instrument, Qureshi (2018a) shows that additional schooling for Pakistani eldest sisters induces younger brothers to pursue more schooling. Joensen and Nielsen (2018) use quasi-random variation in a school pilot scheme to show Danish older siblings' pursuit of advanced math and science coursework increases younger siblings' propensity to take such courses. Dustan (2018) uses randomness induced by Mexico City's high school assignment mechanism to show students prefer schools older siblings have attended. Dahl, Rooth, and Stenberg (2020) show that Swedish older siblings and parents influence the field of study that individuals choose in high school. Gurantz, Hurwitz, and Smith (2020) show sibling spillovers among U.S. students in the taking of Advanced Placement exams. Finally, Goodman et al. (2015) use administrative data to descriptively document that in the United States one-fifth of younger siblings enroll in the same college as their older siblings, and that younger siblings are more likely to enroll in four-year colleges if their older siblings do. [3]

Second, and more broadly, our work informs the literature on determinants of post-secondary education decisions and their implications for inequality. Whether and where to enroll in college, and what subject to specialize in, are deeply important determinants of future occupation and earnings (Altonji et al., 2016). We observe large differences in the college choices of individuals from different social groups characterized by income, parental education and race (Patnaik, Wiswall, and Zafar, 2020). Such group differences have been at least partially attributed to differences in credit constraints (Belley and Lochner, 2007; Dynarski, 2003; Lochner and Monge-Naranjo, 2012;

[2]Some papers have also looked at sibling spillovers on academic performance. These studies have found that individuals experience positive spillovers on academic performance from having older siblings with good teachers (Qureshi, 2018b), older siblings who perform better (Nicoletti and Rabe, 2019), and younger siblings who start school at an older age (Landersø, Nielsen, and Simonsen, 2017). Karbownik and Özek (2019) find positive spillovers for low socioeconomic status siblings, but negative spillovers for high socioeconomic status siblings.

[3]Two contemporaneous working papers show additional evidence on peer effects and sibling spillovers in post-secondary human capital investment decisions in Chile. Barrios-Fernández (2019) uses a regression discontinuity design to investigate extensive margin spillovers from both close neighbors and siblings. Aguirre and Matta (2020) follows an approach similar to ours and studies siblings' spillovers in college choice. The results in both papers are consistent with our findings that close social peers influence post-secondary education choices.

Solis, 2017), school and teacher quality (Card and Krueger, 1992; Goldin and Katz, 2008; Chetty et al., 2014; Deming et al., 2014), and geographical availability of nearby college options (Hillman, 2016). More recent work has shown that limited information could also influence human capital decisions on multiple margins (Bettinger et al., 2012; Hoxby and Turner, 2013; Hastings et al., 2016; Carrell and Sacerdote, 2017; Dynarski et al., 2018).

Causal links between the postsecondary paths of close peers may partly explain persistent college enrollment inequalities between social groups and suggests interventions to improve college access may have multiplier effects. We show that shocks to the education trajectories of older siblings propagate through their family network. Our results imply that the consequences of shocks and barriers to access can be amplified by social influences, so that the challenges faced disproportionately by low income students can have ripple effects into their families and broader communities. Framed more positively, such social influences imply that the effects of policies designed to overcome these obstacles can also be amplified. Financial aid, affirmative action, and other educational interventions likely have larger effects than those typically measured in studies focused on directly treated students because such policies may indirectly benefit younger siblings and other close peers. This multiplier effect may help explain persistent inequalities in postsecondary outcomes and suggests that researchers underestimate the impact of college access interventions by failing to study effects on the wider social network of treated students.

The rest of the paper is organized as follows. Section 2 describes the higher education systems of Chile, Croatia, Sweden and the U.S., along with the data we use, and Section 3 details our empirical strategy. Section 4 presents our main results and Section 5 discusses potential mechanisms. Section 6 concludes. All appendix material can be found in the Online Appendix.

2 Institutions and Data

This section describes the institutional context and data in Chile, Croatia, Sweden, and the U.S. (see the Online Appendix for additional details) As shown in Table I, the four countries are very different in size, economic development and inequality. Their higher education systems are also structured very differently. For example, universities in Chile and the U.S. charge tuition fees, while in Croatia, students receive a fee waiver if they accept the first offer they receive after applying to college, and higher education is free in Sweden.

Most importantly for our analysis, students in Chile, Croatia and Sweden apply to specific college-major combinations through a centralized platform, and admissions decisions are solely based on academic performance. In the U.S., students submit separate applications to each college, and each institution has its own admission process (which may take into account factors beyond academic achievement). Thus, many of our analyses and tables separate the U.S. from the other three countries. We provide details for each country below, followed by a description of how admission score cutoffs generate the discontinuities we exploit for identification, and a summary of how we identify our sibling sample.

2.1 Chile

Chile uses a nation-wide centralized admission system. This system allocates applicants to college-major combinations based only on applicants' preference rankings and academic performance. Students compete for places based on a weighted average of their high school GPA and their scores in different sections of a university admissions exam (PSU).

We use administrative data provided by the Chilean agency in charge of college admissions, DEMRE. They provided individual-level data on all students who registered to take the university admission exam between 2004 and 2018. The data include information on students' performance in high school and on each section of the college admissions exam. The data also contain student-level demographic and socioeconomic characteristics, information on applications, and admissions and enrollment in schools that use the centralized application system.

We complement these data with registers from the Ministry of Education, which record enrollment in all higher education institutions in Chile between 2007 and 2015. This information allows us to build program-year specific measures of retention for the cohorts entering the system in 2006 or later. We also observe some program and institution characteristics, including past students' performance in the labor market (i.e. annual earnings). Finally, we are able to match students to their high schools and observe their academic performance before they start higher education.

2.2 Croatia

Similar to Chile, Croatia has a nation-wide centralized application system through which students rank institutions and compete for places based on their academic performance. In Croatia, students apply to college-major combinations and admissions are based on preference rankings and on a weighted average of their high school GPA and their scores on different sections of the university admission exam.

We use administrative data from the central applications office, (NISpVU), and the Agency for Science and Higher Education (ASHE). The data contain information on all individuals completing high school and applying to higher education between 2012 and 2018. We observe students' demographic characteristics, their performance in high school and on the college admissions exam, and their applications and enrollment in any Croatian college.

2.3 Sweden

Sweden also has a centralized application and admissions process. Students rank their college-major preferences and are admitted to programs based on their rankings and academic performance. Most students are admitted based only on their high school GPA. There is also a voluntary exam that provides a secondary path to admission.

Our Swedish data come from the Swedish Council for Higher Education (UHR). They include applications from the current admissions system (2006–2017) and an older system (1993–2005). The centralized platform has been mandatory since 2006. Prior, universities were not required to select their students through the centralized platform, but the majority of universities used it, especially for their larger programs. Thus, in the early period our sample does not include individuals whose older siblings applied to off-platform options. In the more recent period, our sample includes the universe of applicants.[4] The data also contain information on students' high school GPAs, their scores on the admission exam, and individual and program unique identifiers that allow us to match students and programs to additional registries from Statistics Sweden.

[4] Given the nature of our empirical strategy, not observing these applications does not affect the internal validity of our estimates.

2.4 United States

In the U.S., individuals typically apply to colleges (not to specific college-major combinations), and each college sets its own admission criteria. Most colleges take applicants' SAT scores into account and some require minimum SAT scores.

Our main data come from the College Board, who administer the SAT. We observe all students from the high school classes of 2004–2014 who took the PSAT, SAT, or any Advanced Placement exam (all of which are administered by the College Board). We observe each student's name, home address and high school, as well as self-reported demographic information on gender, race, parental education and family income. We also observe scores from each time a student takes the SAT. We observe all colleges to which students send their SAT scores, and we use these score submissions as a proxy for college applications (Pallais, 2015).

We merge the College Board data with data from the National Student Clearinghouse (NSC). NSC tracks student enrollment in almost all institutes of higher education in the U.S., so we can use NSC data to measure students' initial college enrollment (our focus) and all subsequent enrollments and degrees earned.[5] We combine these data with the federal government's Integrated Postsecondary Education Data System (IPEDS), which contains information on college characteristics such as tuition, median SAT score for enrolled students, whether the school is public or private and whether it is a two- or four-year institution.

2.5 Admission Cutoffs

Our empirical strategy relies on admissions cutoffs. In each country, crossing a program's admissions threshold boosts the probability of gaining admission to and enrolling in the program.

The centralized admissions systems in Chile, Croatia and Sweden generate sharp admissions cutoffs in all oversubscribed college-major combinations.Figure I illustrates how older siblings' admissions and enrollment change at admissions cutoffs. The running variable corresponds to older siblings' application scores centered around their target college-major admission cutoff. In Chile and Croatia, the admissions probability increases from 0 to 1 at the cutoff; in Sweden it increases from 0 to 0.6.

[5]See Dynarski et al. (2015) for NSC data limitations, many of which are for-profit enrollments that most students in our sample are unlikely to attend.

The Swedish application system has two rounds: individuals submit their rank of preferences at the beginning of the process, and at the end of the first round they can decide whether to accept the offer or wait for the results of the next round. Since not all applicants wait, some do not receive an offer to their preferred college-major combination even when their application scores were above the cutoff generated in the second round. This explains why the admission probability above the cutoff is only 0.6. Since each individual represents only one application in a much larger pool of applicants, she cannot predict or manipulate the final cutoffs. Figure I also shows that receiving an offer for a specific college-major increases the probability of enrolling there. However, admission does not translate one-to-one into enrollment in any of these countries.

In the U.S., where the higher education system and admissions process are decentralized, we focus on the subset of colleges that clearly apply minimum SAT cutoffs in their admissions process but do not publicly announce this process. Using data on SAT scores, applications and enrollment, we empirically identify 21 colleges that appear to employ SAT cutoffs.[6] These colleges are largely public institutions (16 public, 5 private) with an average enrollment of over 10,000 full-time equivalent students, and they are located in eight states on the East coast. The SAT thresholds for these colleges range from 720 to 1060, with students widely distributed across colleges and thresholds. Figure II illustrates how the probability of enrolling in one of these threshold-using colleges nearly doubles at the identified cutoffs.

2.6 Identifying Siblings

Our research question relies on identifying siblings. In Chile, students provide their parents' national ID numbers when registering for the university admission exam. We use this unique identifier to match all siblings that correctly reported these numbers for at least one parent.[7] Nearly all students graduating high school in Chile register for the college entrance exam. Although registering for the admission exam costs around USD 40, students graduating from subsidized high schools—93% of total high school enrollment—are eligible for a fee waiver that is automatically activated when they

[6]The Online Appendix explains in detail how we identified these colleges. In order to have quasi-random variation in older siblings' education trajectories, our sample focuses on sibling pairs in which the older sibling applies to one of these 21 colleges.

[7]79.4% of students report a valid national ID number for at least one of their parents. 77.2% report their mother's national ID number.

register for the exam. Thus, even students who do not plan to apply to college typically register for the exam. We complement this data with registers from the Ministry of Health that contain records for individuals born on or after 1992 and their mothers. We use the national IDs from these data to link siblings in cohorts completing their secondary education in 2010 or later.

In Croatia and the U.S., we identify siblings through home addresses and surnames. In Croatia, we rely on individual reports generated by high schools at the end of each academic year. In the U.S., we use the information provided by students when they register for a College Board exam. We identify siblings as pairs of students from different high school classes whose last name and home address match perfectly. We refer to anyone for whom we fail to identify a sibling as an "only child". This approach should yield few false positives, such as cousins living together. This approach, however, likely generates many false negatives in which we mistakenly label individuals with siblings as only children. False negatives come from two sources. First, and unlikely to generate many false negatives, siblings may record their last names or home address differently.Second, in the U.S. where we observe students' addresses only when they register for an admission exam, we fail to identify siblings in families that change residential addresses. Failing to identify siblings will have no impact on the internal validity of our estimates, but it does affect both sample size and the characteristics of the population we study.

Statistics Sweden provided family linkages for our full sample in Sweden. Thus, we observe the full set of sibling pairs regardless of whether they registered for an admission exam.

Because some families have more than two siblings, we use each family's oldest applying sibling to determine the treatment status of all younger siblings. The vast majority of siblings in our data appear in pairs, but some come from families where we identify three or more siblings.[8] We define families' demographic characteristics based on the oldest sibling for consistency across siblings and because treatment status is determined when the oldest sibling applies to college. We structure the data so that each observation is a younger sibling, whose characteristics and treatment status are assigned based on their oldest sibling. If older siblings applied to college multiple times, we only use the first set of applications they submitted.

[8] In the Online Appendix we present alternative specifications in which we focus instead on: (1) the closest older sibling and (2) the first- and second-born children.. The results are remarkably similar to the ones we report in the body of the paper.

Our sample consists of approximately $140,000$ sibling pairs in Chile, $17,000$ in Croatia, $220,000$ in Sweden, and $40,000$ in the U.S.. In Chile, Croatia, and Sweden, these are the number of younger siblings who had an older sibling with at least one active application to an oversubscribed program and an application score within the relevant bandwidths for our regression discontinuity design. In the U.S., these are the younger siblings with an older sibling who applied to at least one of the 21 cutoff using colleges in our sample, and had an SAT score near the admissions cutoff.

Table II presents summary statistics for these sibling pairs and for the full set of potential applicants. Individuals with older siblings who already applied to higher education are slightly younger when they apply to college than the rest of applicants and, not surprisingly, they come from larger households. Since our sample is based on families with at least one college-applying child, it is not surprising that some differences also arise when we look at socioeconomic and academic variables. In Chile and the U.S., individuals in the discontinuity sample come from wealthier and more educated households than the rest of the potential applicants. They are also more likely to take the admission exam, and with the exception of the U.S., perform better on it.

3 Empirical Strategy

We use admission score cutoffs to identify the impacts of older siblings' college trajectories on younger siblings' college and major choice. In Chile, Croatia and Sweden, we exploit thousands of cutoffs generated by the deferred acceptance admission systems universities use to select their students. In the U.S., we exploit the variation generated by cutoffs that 21 colleges use in their admission processes (and do not disclose to students).

We use these admission cutoffs in a regression discontinuity (RD) design, which helps us overcome typical challenges in identifying sibling effects. The RD compares younger siblings whose older siblings are similar to one another across most dimensions except for scoring just above or just below an admission cutoff. These small differences in test scores change the educational trajectories of the older siblings and have the potential to influence younger siblings. Since individuals whose older siblings are near an admission threshold are very similar, the RD allows us to rule out that the estimated effects are driven by differences in individual or family characteristics, eliminating concerns about correlated effects. We can also rule out concerns related to the reflection problem

Manski (1993) because the variation in older siblings' education paths comes only from being above or below the cutoff, and thus cannot be affected by the choices of younger siblings.

3.1 Method

This section describes the specification we use to estimate how older siblings' higher education trajectories influence the colleges and majors to which their younger siblings apply and enroll. We separately estimate sibling spillovers in each country. For each sample, we pool observations from all applicants to the relevant colleges and college-majors (which includes all oversubscribed college-majors in Chile, Croatia and Sweden and "cutoff-using" colleges in the U.S.). We center older siblings' application scores around the admission cutoff of their "target" college or "target" college-major depending on the setting, and estimate the effect of an older sibling being above the relevant cutoff. The following equation describes our baseline specification:[9]

$$y_{icmt\tau} = \beta \times \text{above-cutoff}_{icm\tau} + f(a_{icm\tau}; \theta) + \mu_{cm\tau} + \varepsilon_{icmt\tau}. \quad (1)$$

$y_{icmt\tau}$ indicates whether the younger sibling from sibling-pair i and birth year t whose older sibling was near the admission cutoff of major m in college c in period τ applies to or enrolls in the target college-major, college or major of the older sibling. above-cutoff$_{icm\tau}$ is a dummy variable indicating whether the older sibling from sibling-pair i had an admission score $a_{icm\tau}$ above the cutoff ($c_{cm\tau}$) of major m offered by college c in year τ ($a_{icm\tau} \geq c_{cm\tau}$). $f(a_{icm\tau})$ is a function of the application score of the older sibling of the sibling-pair i for major m offered by college c in year τ. $\mu_{cmt\tau}$ is a fixed effect for the older sibling's cohort and target college-major, and ε_{icmt} is an error term.

By including fixed effects $\mu_{cmt\tau}$ for each cutoff, our identification variation only comes from individuals whose older siblings applied to the same target college in the U.S. or the same target college-major in Chile, Croatia and Sweden.

Our main results are based on local linear regressions in which we use a uniform kernel and control

[9] In the U.S. the variation is at the college level, so we can eliminate the major subscript. In addition, the cutoffs are constant over time, thus, the term $\mu_{cm\tau}$ is replaced by μ_c and μ_τ. See the Online Appendix for a detailed description of the procedure we use to identify these cutoffs in the U.S..

for the running variable with the following linear function:

$$f(a_{imc\tau}; \theta) = \theta_0 a_{imc\tau} + \theta_1 a_{imc\tau} \times 1[a_{imc\tau} \geq c_{mc\tau}].$$

This specification allows the slope to change at the admission cutoff. In the Online Appendix we show that our results are robust to using a quadratic polynomial of $a_{imc\tau}$, a triangular kernel, and to allowing the slope of the running variable to be different for each admission cutoff. To study the effect of enrollment—instead of the effect of admission—we instrument older siblings' enrollment ($\text{enrolls}_{imc\tau}$) with an indicator for admission ($\text{above-cutoff}_{imc\tau}$).

We compute optimal bandwidths according to Calonico et al. (2014). In the U.S. analyses we use a bandwidth of 93 SAT points, which is the median (and mean) optimal bandwidth for the main outcomes that we study. In Chile, Croatia and Sweden, we compute the optimal bandwidth for our three main outcomes: ranking the older sibling's target option in the first preference, ranking it in any preference, and enrolling in it. For each country, we use the smallest of these bandwidths, so that our bandwidths are consistent across outcomes and specifications.

In the centralized admission systems used in Chile, Croatia and Sweden, individuals can be admitted to at most one college-major. However, they can narrowly miss several options ranked higher in their application list. This means that they may belong to more than one college-major marginal group. We cluster standard errors at the family level to account for the fact that each older sibling may appear several times in our estimation sample if she is near two or more cutoffs, or if she has more than one younger sibling.

In the Online Appendix we present a variety of additional robustness checks. As expected, changes in the admission status of younger siblings do not have an effect on older siblings, our estimates are robust to different bandwidth choices, and placebo cutoffs do not generate a significant effect on any of the outcomes studied.

3.2 Estimation Samples

In Chile, Croatia and Sweden, we use information on older siblings' next best option to define three estimation samples that we use to study sibling spillovers on three different outcomes: college choice, college-major choice, and major choice (across all colleges). The Online Appendix describes these samples in greater detail.

- College-Major Sample—Since college-major combinations are unique, being above or below a cutoff always changes the college-major combination to which an older sibling is admitted.[10] This sample includes all individuals whose older siblings are within a given bandwidth for a target cutoff.
- College Sample—Our estimates of sibling spillovers on college choices are based on individuals whose older siblings' target and next best college-major preferences are taught at different colleges. For these older siblings, being below or above the admission threshold changes the college to which they are assigned.[11]
- Major Sample—To investigate sibling spillovers in major choices, we exclude all individuals whose older siblings' target and next best college-major option correspond to the same major.[12]

3.3 Identifying Assumptions and Alternative Specifications

As in any RD setting, our estimates rely on two key assumptions. First, individuals should not be able to manipulate their application scores around the admission cutoff. Since the exact cutoffs are not known when students apply and students cannot affect their scores once they have applied, such manipulation is very unlikely. We find no indication of manipulation when we study the distributions of the running variable in each setting (see the Online Appendix for more details).

Second, to interpret changes in individuals' outcomes as a result of the admission status of their older siblings, there cannot be discontinuities in potential confounders at the cutoff (i.e. the only

[10]In some cases, universities use different names for similar majors or change them over time. Thus, to make majors comparable across institutions, time, and settings, we classify them into three digit-level ISCED codes. An individual whose older sibling enrolls in economics at the University of Chile is said to choose the same major as her older sibling if she applies to Economics (0311) in any college. She is said to choose the same college-major combination if she applies to the exact same degree—Economics—in the exact same college—University of Chile.

[11]In the Online Appendix we present additional results that investigate sibling spillovers on college choice in a modified sample. In this alternative sample we only include individuals whose older siblings' target and next best options correspond to the same major, but are taught at different colleges (i.e. Economics at Princeton, and Economics at Boston University). The results are very similar to the ones we obtain using the College Sample.

[12]In the Online Appendix we present results that focus on individuals whose older siblings' target and next best college-major are taught in the same college. In this alternative sample, crossing the admission threshold changes the older sibling's major, but not college.

relevant difference at the cutoff must be older siblings' admission). The Online Appendix shows that this is indeed the case for a rich set of socioeconomic and demographic characteristics.

To investigate the effect of an older sibling's enrollment on younger siblings choices, we rely on a fuzzy regression discontinuity design. This approach can be thought as an instrumental variable strategy, meaning that to interpret our estimates as a local average treatment effect (LATE) we need to satisfy the assumptions discussed by Imbens and Angrist (1994).[13] In addition to the usual IV assumptions, we also need to assume that receiving an offer for a specific college or college-major does not make enrollment in a different option more likely (see the Online Appendix for more details). Given the structure of the admission systems that we study, this additional assumption is not very demanding.[14]

We also show, in the Online Appendix, that older siblings' marginal admission to their target college-major does not generate a relevant difference in their younger siblings' college enrollment in Chile, Croatia and Sweden (i.e., probability of enrolling in any college). This result relieves concerns about increases in applications and enrollment in an older sibling's target choice being driven by a general increase in college enrollment. This issue is more relevant in the U.S., where we document that older siblings crossing an admission threshold induce an increase in four-year college enrollment among younger siblings. Decomposing this extensive margin response among those following their older siblings to the same college and those going somewhere else helps us understand how siblings influence higher education decisions. In section 4 we discuss this decomposition in more detail and show that the increase that we find in younger siblings' enrollment in the target college of their older siblings in the U.S. is much larger than the increase we would observe in the absence of sibling spillovers in the choice of college.

[13]Independence, relevance, exclusion and monotonicity. In this setting, independence is satisfied around the cutoff. We show that there is a first stage in Figure I. The exclusion restriction implies that the only way older siblings' admission to a college or college-major affects younger siblings' outcomes is by increasing older siblings' enrollment in that option. Finally, the monotonicity assumption means that admission to a college or college-major weakly increases the probability of enrollment in that option (i.e. admission does not decrease the enrollment probability).

[14]In Chile—where not all colleges use centralized admissions—or in the U.S.—where each school runs its own admission system—this assumption could be violated if, for instance, other colleges were able to offer scholarships or other types of incentives to attract students marginally above the admission cutoffs for other institutions. Although it does not seem very likely that colleges would define students' incentives based on admission cutoffs that they only observe ex-post or do not observe at all, we cannot completely rule out this possibility. In Croatia—where students lose their funding if they reject an offer—and Sweden—where there are no tuition fees and where all universities allocate places through the centralized platform—violations of this assumption seem unlikely.

Kirkebøen et al. (2016) argue that when estimating returns to fields of study, controlling for the next best option is important both for identification and for interpreting the results. Since we observe older siblings' next best options in Chile, Croatia and Sweden, in the Online Appendix we present results that include controls for two-way interacted fixed effects for both target and next-best major-college. These estimates are very similar to the ones presented in Section 4, even though including two-way fixed-effects puts a considerable strain on statistical power. It is important to note, however, that our research question is very different from the one addressed in Kirkebøen, Leuven, and Mogstad (2016). Thus, while in their context it is important to identify the baseline against which returns are computed, it is less important here because we are interested in whether individuals are more likely to apply and enroll in a college program if an older sibling enrolls there independently of her counterfactual option.[15]

Our baseline specification compares the higher education choices of individuals whose older siblings are marginally above or below specific admission cutoffs. Since we pool many admission cutoffs, our estimates represent a weighted average of the effect of having an older sibling crossing an admission threshold and gaining admission to their target program as a consequence. At each admission cutoff, the counterfactual is a mix of the next best options for each older sibling. By using the samples that we defined earlier in this section, we guarantee that the next best option for the older sibling is a different major-college, a different college, or a different major depending on the outcome we are investigating.[16]

To gain a better understanding of what is driving the average effects we document, we exploit the information we have on the target and next best options of older siblings in Chile, Croatia and Sweden. We estimate the following specification:

[15] The Online Appendix discusses in detail the identifying assumptions that we require in this setting. Considering that in our case there are thousands of college-major combinations available, it is not feasible to follow the approach of Kirkebøen, Leuven, and Mogstad (2016) and independently estimate responses with respect to each next best option.

[16] In the U.S. we do not observe next best options. However, since applications are made at the college level, crossing the threshold changes the college to which individuals are admitted. In the Online Appendix we show that in the U.S., crossing the threshold increases older siblings' probability of attending a four-year college by 36 percentage points. The probability of enrolling in some college—either a two- or four-year—is not affected. This means that for an important share of U.S. older siblings compliers, the next best option is a two-year college.

$$y_{icmt} = \alpha_0 + \sum_{j=1}^{4} \beta_j \text{above-cutoff}_{icm\tau} \times Q_j + \sum_{j=1}^{4} \gamma_j Q_j + f(a_{icm\tau};\theta) + \mu_{cm\tau} + \mu_{c'm'\tau} + \varepsilon_{imct\tau} \quad (2)$$

As before, y_{icmt} is a dummy variable that indicates whether younger siblings apply to or enroll in their older sibling's target program. However, this time we estimate the effect of crossing the admissions threshold for four groups. To define these groups we first compute the difference between older siblings' target and next best option along a relevant dimension (expected earnings, peer quality or first year retention rate). Each group Q_j corresponds to a quartile in the distribution of this difference. While the differences in the bottom quartile are negative, in the top quartile they are positive. This specification also controls for target ($\mu_{cm\tau}$) and next-best ($\mu_{c'm'\tau}$) option fixed effects.

For older siblings, crossing the admission threshold of their target program changes the characteristics of the college-major to which they are allocated. This specification allows older siblings' effects on their younger siblings to vary with the size of the change they experience when crossing the threshold. We further investigate heterogeneous responses by estimating a similar specification in which we construct quartiles from the levels of characteristics in older siblings' target programs instead of the differences with respect to their next best options.

4 Results

This section presents results on sibling spillovers. First, we show that younger siblings are likely to follow the same higher education trajectory as their older siblings. Second, we show that following an older sibling can be of great consequence, sometimes dramatically shifting the type of college in which a student enrolls. In some instances, this shift impacts the quality of the younger sibling's college choice, as measured by peer achievement, expected earnings and degree completion rates.

4.1 Following an Older Sibling

Across all four countries, an older siblings' admission to a college increases their younger sibling's probability of applying to and enrolling in that same college. We illustrate this causal relationship in Figure III for Chile, Croatia and Sweden and in Figure IV for the U.S.. These figures show the reduced-form relationships between an older siblings' admissions score and the younger siblings' application to and enrollment in the same college for each country. Each figure indicates a sharp discontinuity in the younger sibling's outcome as a function of the older sibling's admissions score. In Chile, Croatia, and Sweden, younger siblings are more likely to rank a college first in their application portfolio if their sibling is admitted. The rows labeled "older sibling above cutoff"in Table III show the reduced form estimates for Chile, Croatia, and Sweden. In the U.S., younger siblings are 2.3 pp more likely to apply to and 1.4 pp more likely to enroll in the older sibling's target college if the older sibling scores above the admission cutoff.

Figure V shows that individuals are more likely to apply to and enroll in a college-major combination if an older sibling was admitted to it. Figure VI, however, shows that older siblings' admission into their target major does not significantly impact the probability that their younger siblings will apply to or enroll in that major (at any institution). Thus, the influence on major choice seems very local; individuals only follow majors in the same college of the older sibling.

Next, we combine these reduced form estimates with our first stage results to obtain the 2sls estimates in Tables III and IV. These estimates represent the effect of an older sibling's enrollment in a target college, college-major, or major on the younger sibling's probability of applying to or enrolling in the same program.[17]

Younger siblings are more likely to rank a college as their first preference, to apply to the college, and to enroll in it when the older sibling enrolls (as a result of barely gaining admission). Columns (4)–(6) in Table III summarize these results in Chile, Croatia and Sweden. In these countries, individuals are 6.7 pp to 12 pp more likely to rank their older siblings' target college as their first preference and between 7.6 pp and 13.2 pp more likely to apply (in any preference rank) when the older sibling enrolls there. The increase in applications to the older sibling's target college also translates into an increase in enrollment between 3.8 pp and 8.4 pp.

Older siblings have larger effects on applications and enrollment in the U.S.. Table IV shows that

[17] If an older sibling's admission to a target option affects younger sibling choices even when the older sibling does not enroll there, the IV estimates we present would overstate the effects of an older sibling's enrollment on younger sibling choices. Note, however, that the reduced form results will still be valid.

younger siblings are 27.9 pp more likely to apply to and 17.2 pp more likely to enroll in their older siblings' target college if the older sibling was admitted and enrolled there. Thus, in all four countries, an older sibling's enrollment in a particular college increases the likelihood of applying to and enrolling in that college.[18] We also leverage the rich data on college-major and major preferences in Chile, Croatia, and Sweden to examine whether an older sibling's college-major or major choice leads the younger sibling to follow them in these margins as well. In these countries, an older sibling's enrollment in her target college-major combination makes younger siblings between 1.2 pp to 2.0 pp more likely to rank the exact same option in their first preference, between 2.3 pp and 3.6 pp more likely to rank it in any preference, and between 0.5 pp to 1.3 pp more likely to enroll in it. These estimates are smaller than those for enrollment in the same college, indicating that many students who follow an older sibling to a college do not choose the same major. These, however, are still meaningful effects, especially when taking into account the low baseline levels in the control group.

Finally, in columns (7)–(9) of Table III, we study whether preferences for majors—independent of the college that offers them—are influenced by older siblings' choices. We focus on the major sample defined in Section 3, which only includes individuals whose older sibling's target and next-best option correspond to different majors. In contrast to the strong college-choice spillover effects, we find almost no influence on major choices. None of the estimates are statistically significant at conventional levels and, in general, the coefficients are small.

These results show that younger siblings' major choices are only locally affected. Younger siblings are not more likely to apply to or enroll in the older sibling's major in any college, but they do follow the older sibling to the same college-major. To further investigate these effects on major choices, we build a new sample that only includes individuals whose older sibling's target and next best option are offered by the same college (e.g. ranked first economics at Princeton and second

[18] In the next section, we show that older siblings' enrollment in their target college increases enrollment in any four-year college. This means that the effect that we document could be in part a mechanical consequence of the increase in the share of individuals going to any four-year college. However, given the size of the effects, it is unlikely that our results are only a mechanical consequence of this increase. On the left of the admission cutoffs the share of individuals enrolling in the target college of their older sibling is 1.58% (0.006/0.38). On the right hand side it is 29.2% (0.178/0.609). If preferences were stable around the cutoff and older siblings did not affect preferences for specific colleges, we should find 1 pp (1.58% $\times$ 60.5%) of the younger siblings on the right hand side enrolling in the target college of their older sibling. However, the increase in enrollment is 17.2 pp, well above the 0.4 pp increase that we should find in the absence of such spillovers.

sociology at Princeton). In the centralized admission systems used in Chile, Croatia and Sweden, individuals learn their scores before submitting their applications. This timing means that if, after receiving their scores, younger siblings believe they are unlikely to gain admission to their older sibling's college-major they might not apply there. Thus, for this exercise we further restrict the sample to individuals who are likely to be admitted to their older siblings' target college-major (we present these results in the Online Appendix). Although our estimates are not always precise, the sibling spillovers on college-major choices in this sample are larger than the ones we present here.[19]

We find evidence across all four countries that an older sibling's educational trajectory has a causal effect on the younger sibling application and enrollment decisions. Next, we examine the consequences of this behavior.

4.2 Does Following an Older Sibling Matter?

In this section, we examine when students are most likely to follow their older siblings and whether this changes the types of colleges and majors that younger siblings attend.

First, we show that younger siblings follow older siblings independent of the characteristics of the program attended by the older sibling. We use the full rank of preferences observed for applicants in Chile, Croatia and Sweden to estimate how younger siblings' choices vary with the characteristics of their older sibling's counterfactual options. We estimate specification 2, which allows younger siblings' responses to change depending on the difference between the older sibling's target and next best options along three dimensions: expected earnings, peer quality, and first year retention rates. This means that these specifications only include observations for which we observe both the older sibling's target and next best options. We classify the differences in quartiles and allow the effect to be different for sibling pairs in each quartile.

Older siblings' counterfactual options are often very similar. However, there are some cases in which these differences are more significant. For instance, the average difference in annual expected earnings in the first quartile is negative. In Chile, it is close to USD 10,000 and in Sweden to USD

[19] In the Online Appendix we present results from a similar exercise in which we investigate spillovers on college choice focusing only on individuals whose older siblings' target and next best options correspond to the same major, but are offered at different colleges. The results are very similar to the ones we document for college choice in the current section.

7,000. In contrast, the average difference in annual expected earnings in the fourth quartile is positive, reaching USD 20,000 in Chile and USD 10,000 in Sweden. A similar pattern arises when focusing on the other quality indexes that we investigate. Average differences in peer quality in the first quartile of the distribution are -0.22σ, -1.4σ, and -0.14σ in Chile, Croatia, and Sweden respectively. The same figures in the fourth quartile are 0.5qσ, 1.6σ, and 0.59σ. Finally, the average difference in first-year retention rates in the first quartile is -8.3 pp in Chile, and -14.1 pp in Sweden. As in the previous cases, in the fourth quartile, these average differences turn positive reaching 15.3 pp in Chile and 22.2 pp in Sweden.

We find that younger siblings not only follow their older siblings when the older sibling is on the margin of very similar alternatives, but also when the differences between these options are large. Table V summarizes these results. It indicates that, independent of the difference between older siblings' target and next best options, having an older sibling admitted to a given college or college-major increases the probability that their younger siblings apply there. This means that some individuals follow their older siblings to institutions with worse peers, lower retention rates and lower expected earnings than the older sibling's next best option.

We find similar patterns when we estimate specification 2, but define the quartiles based on the levels of the characteristics in older siblings' target options and not on differences. Table VI shows that an older sibling's admission to her target college-major increases the probability that the younger sibling applies to the same college, independent of the quality of the older sibling's target. The effects are remarkably stable across groups in Croatia and Sweden. The results in Chile are, for the most part, positive and significant. The only individuals for whom we find no significant effects are those whose older siblings enroll in a college-major with very low retention rates. We also find positive and significant effects when looking at applications to the older sibling's target college-major (the Online Appendix presents similar results focusing on enrollment instead of on applications).

Overall, our results show that individuals follow their older siblings' both when crossing the admission threshold implies a gain and when it implies a loss in expected earnings, peer quality or first year retention rates. These results suggest that individuals do not learn about all available alternatives and their relative quality from their older siblings; instead, they seem to learn about the institution in which the older sibling enrolls. These findings also suggest that social spillovers are likely to amplify the effects of frictions and barriers that prevent individuals from making optimal education choices. By affecting the choices of close peers, these obstacles add to the inequality that we observe in educational trajectories.

In the U.S. we do not observe applicants' counterfactual college options. However, we find that crossing an admissions threshold increases older siblings' likelihood of enrolling in a four-year college. When measuring the outcomes of older and younger siblings, we focus on their initial enrollment decisions; we study what they do the year after completing high school. This increase is largely due to these students being more likely to attend their target (four-year) college than a two-year college.[20] IV estimates indicate that nearly half of the marginal older siblings induced to attend target colleges by admissions thresholds would not have attended four-year colleges if they had not passed the admissions threshold.[21] This behavior contrasts with what we observe in Chile, Croatia and Sweden, where most of the older siblings in our sample enroll in a four-year college.[22]

Older siblings' increased access to four-year colleges has important consequences for younger siblings in the U.S.. Plot (c) of Figure IV indicates that older siblings' marginal admission to their target college substantially increases younger siblings' enrollment in four-year colleges. The IV estimate in column (1) of Table IV shows that applicants whose older siblings enroll in their target four-year college are 23 pp more likely to enroll in any four-year college than students whose older siblings just miss the cutoff. Column (2) shows a small and insignificant decrease in two-year college enrollment. This decrease indicates that the older sibling's admission to her target college leads to some younger sibling movement from two-year to four-year colleges, as well as increased enrollment among younger siblings who would not have attended college otherwise.

This increase in enrollment is also evident in columns (3) and (4) of Table IV, which show that older siblings' admission to target colleges improves the quality of the educational path followed by younger siblings. Here we define quality as the bachelor's degree completion rate and the standard-

[20]Figure II shows that older siblings with SAT scores above the target college's admission cutoff are 8.5 pp more likely to attend that college than students with scores just below the threshold.

[21]The Online Appendix shows that older siblings' scoring above the cutoff in their target college are 36 pp points more likely to attend a four-year college, and 28 pp less likely to attend a two-year college. Thus, only a small fraction of the marginal older siblings would not have attended college if they had not crossed the threshold.

[22]The Online Appendix shows that in these three countries older siblings' admission to their target option does not affect younger siblings' probability of attending a four-year college.

ized PSAT scores for students attending the institution.[23] We assign students who do not enroll in college a bachelor's degree completion rate of zero, and the mean PSAT score for all students who do not enroll in college. Younger siblings whose older sibling attended the target college enroll in colleges with graduation rates 18 pp higher and peer quality 0.31 standard deviations higher than the colleges they would have chosen otherwise.

Our results also indicate that the most responsive younger siblings are the "uncertain college-goers". These are students whose predicted probability of attending college—based on observable characteristics—is in the bottom third of our sample.[24] Older siblings appear to have little impact on the type of institution attended by younger siblings who are probable college goers. Overall, these results are consistent with older siblings providing general college information, which makes younger siblings—especially those less likely to know about college options—more likely to enroll in a four-year college.[25]

The results discussed in this section show that shocks affecting an older sibling's education trajectory can be of great consequence for their younger siblings. Across all four countries, younger siblings follow their older siblings even when there are large differences in their counterfactual options. In the U.S., where many of the younger siblings in our sample are on the margin of attending college, an older sibling's enrollment in a four-year college induces them to follow the same path.

5 Mechanisms

Our results in Section 4 show that older siblings' higher education trajectories influence the trajectories of their younger siblings. Older siblings' education pathways play an important role in the younger siblings' decisions both to attend college and which college to attend. We also find spillover effects on the choice of major, though they seem to be relevant only for individuals that

[23]We build a peer quality measure following Smith and Stange (2016) and compute the average standardized PSAT score of initial enrollees for each college. This peer quality measure allows for comparisons between two- and four-year institutions; two-year colleges do not require SAT scores and thus lack a peer quality measure in IPEDS.

We build a second quality index using the NSC data to compute the fraction of initial enrollees at each college who earn a B.A. from any college within six years. Unlike the IPEDS graduation rate measures, this accounts for transfers between institutions and allows for direct comparisons of two- and four-year colleges.

[24]To predict the likelihood of enrolling in a four-year college, we use the sample of "only children" and the socioeconomic and demographic characteristics that we observe in the College Board data.

[25]Additional results in the Online Appendix show that the strength of sibling spillovers does not vary by socioeconomic status for siblings in Chile, Croatia and Sweden. However, in these countries most older siblings in our samples are likely to enroll in four-year colleges, suggesting that the individuals we study are not marginal college goers.

can follow their older siblings to the exact same college-major combination.

To properly identify causal effects, our analyses focus on changes in older siblings' educational paths that arise from admissions cutoffs. This is likely to capture only a small part of siblings' influence on education trajectories. Considering the source of variation that we exploit, and the fact that an older sibling is only one member of an individual's social network, our estimated effects are large.

Our results are also large compared to the effects of previously studied college-going interventions. Most nudge-style informational interventions at the state or national scale fail to meaningfully affect college enrollment choices. Higher touch interventions that complement information with some type of personalized support have been more effective. Bettinger et al. (2012), for instance, finds that helping families apply for funding increases college enrollment by 8 pp, while Carrell and Sacerdote (2017) finds that assigning females to a mentoring program increases college enrollment by 15 pp; among those who actually took part in the program the effect is twice as large. These estimates are similar to the increase we document in four-year college enrollment in the U.S.. In terms of college choice, Hoxby and Turner (2015) shows that providing students with customized information about different dimensions of the college experience and reducing application costs increases enrollment in institutions with similar peers by 5.3 pp. This effect is smaller than our estimate of sibling spillovers on college choices in the U.S., and is of similar magnitude to our estimates from the other three countries.

In the rest of this section, we estimate heterogeneity in sibling effects across settings and outcomes to investigate the mechanisms behind sibling spillovers. We focus on three broad classes of mechanisms through which older siblings are likely to affect the choices of their younger siblings. First, the older sibling's educational trajectory could affect the costs of attending specific colleges or majors. Second, the older sibling's outcomes could affect the younger siblings' preferences over different higher education trajectories. Finally, older siblings' experiences could affect the options younger siblings consider by improving their admission probabilities or by making some options more salients.

5.1 Heterogeneity in Sibling Spillovers

This section presents several heterogeneity analyses to help us investigate potential mechanisms driving our results.

First, we explore differences in younger siblings' responses to their older siblings' college choices based on siblings' age differences and genders.[26] Table VII summarizes these results. Column (1) investigates differences by sibling age gap and siblings' gender on enrollment in any four-year college; columns (2)–(5) focus on the probability that younger siblings apply to their older sibling's target college; and columns (6)–(8) focus on the probability that they apply to their older sibling's target college-major.

Results from the U.S. suggest that the effects on the decision to enroll in a four-year college and on the specific college chosen are stronger for siblings born five or more years apart. These results contrast with our findings for Chile, Croatia and Sweden, where we find that the probability of following an older sibling to her target college decreases with the age gap. Despite this decrease, there is still a significant and meaningful effect, even for siblings born more than five years apart. We find a similar pattern when looking at the choice of college-major. In this case, the magnitude of the effect also decreases with the age gap, but there is still a significant effect for siblings with large age differences.

The fact that siblings who are more than five years older than their younger sibling still influence their college choices means that sibling spillovers are not just about siblings wanting to be on campus together. In addition, the shrinking size of spillover effects as age gaps grow in Chile, Croatia and Sweden might indicate that individuals pay more attention to a sibling who is more similar to them. Even if age difference does not explain how close two siblings are, the experience of an older sibling closer in age might be a better proxy for what younger siblings could expect from a college.

To further explore how siblings' similarity affects the strength of the sibling spillovers, we investigate whether responses vary by siblings' gender. In the U.S., effects on four-year college enrollment are

[26] The analyses presented in this section focus on **applications**. We present similar results for **enrollment** in the Online Appendix. The Online Appendix also includes a more detailed discussion on gender differences.

stronger among siblings of opposite genders, but we find no gender differences in the probability of applying to the older sibling's target college. In Chile, Croatia and Sweden, we do not find heterogeneous effects by gender in the probability of following an older sibling to college. However, when looking at the probability of applying to the older sibling's target college-major, we find that individuals are more likely to follow an older sibling of the same gender.[27]

Next, we explore whether sibling spillover effects persist if the older sibling has a negative experience in college. We estimate the effect of older siblings' college enrollment for older siblings who drop out of their target program. Since the decision to leave college could be affected by having a younger sibling at the same school, we focus on first year dropouts and siblings who are at least two years apart in age.

Table VIII shows that siblings' effects disappear if the older sibling drops out. This result is consistent with the hypothesis that individuals learn from their older siblings' college experiences whether a specific college-major or college would be a good match for them. The results of this exercise should be interpreted with caution because dropping out of college is not random. Although controlling for the baseline effect of dropout helps us capture some of the differences between individuals who remain at or leave a particular college, there could still be differences we are unable to control for. In addition, we can only build the dropout variable for older siblings who actually enroll somewhere.[28]

These results suggest that younger siblings are more likely to follow their older sibling if the older sibling has a positive experience in college. However, in light of the results from section 4.1, this effect primarily operates through dimensions that are not related to a program's average expected earnings, peer quality and retention rates. Thus, the specific experience of the sibling seems much more important than the average experience of students in the program.

[27]The Online Appendix presents a more detailed discussion of heterogeneous effects by gender. The heterogeneous effects we find in the probability of following an older sibling to the same college-major is driven by males being more likely to follow older brothers. Indeed, we do not find evidence of females' college-major choices affecting or being affected by a sibling.

[28]The Online Appendix shows that in Chile and Sweden, marginal admission does not translate into increases in older siblings' college enrollment. Thus, in these countries, we focus on older siblings who enroll in college. In the United States, on the other hand, marginal admission increases older siblings' enrollment and we include everyone in the estimation sample. Since we can only define dropouts for older siblings who enroll, this specification does not control for its main effect.

5.2 Sibling Spillovers on Academic Performance

Next, we study older siblings' effects on younger siblings' college preparation and academic performance. We estimate our baseline specification using various measures of younger siblings' academic performance as the outcomes. When looking at changes in younger siblings' scores, we focus on the subset of individuals who actually take the test. Since not all younger siblings take an admissions exam, these results need to be interpreted with caution. We use the same bandwidths as in the previous sections.

Table IX shows that an older sibling's enrollment in her target program does not significantly change her younger siblings' high school grade point average. We also find no significant increases in the probability of taking the college admission exam.[29] In Chile and Croatia, we do not find spillovers on younger siblings' performance on the college admission exam. In Sweden and the U.S., younger siblings perform better when their older siblings enroll in their target program. The results in Sweden should be interpreted with caution because we find a decrease in test-taking rates, so this result could be driven by selection. The increased exam performance in the U.S. is imprecisely estimated, but large enough that it may be economically meaningful.

Finally, we do not find significant increases in college applications. In Chile, Croatia and Sweden, where we study the effect on applications using a dummy variable for whether younger siblings submit at least one application, we find a small and insignificant decrease in applications. In the U.S., where we look instead at the total number of applications submitted, we find that an older sibling's enrollment in her target college increases the number of applications her younger sibling submits by 0.159. This is also a small and insignificant effect.

On balance, these results suggest that sibling effects on college and college-major choices are not driven by an improvement in the academic performance or college preparation of younger siblings.

[29] In Sweden, where students do not need to take the admission exam to apply, we find a small (significant) decrease in the share of younger siblings taking it. In the U.S. we find that individuals whose older siblings enroll in their target college are 7.3 pp more likely to take the SAT, but this coefficient is not statistically significant.

5.3 Discussion

We discuss and explore the three classes of mechanisms introduced at the beginning of Section 5 that could drive the sibling effects that we document.

First, older siblings' college enrollment can affect the costs of specific options and the family budget constraint. On the extensive margin, an older sibling's attendance at her target college could reduce the resources available for financing the younger sibling's education. However, our results from the U.S. indicate that older siblings' enrollment increases younger siblings' four-year college enrollment. This indicates that the additional costs faced by families when one child enrolls in college do not outweigh the positive effects on the younger sibling's college enrollment.[30]

An older sibling's enrollment in a particular college campus may affect the costs faced by younger siblings in other ways. For instance, siblings attending the same college may save on commuting and living costs. An older sibling's enrollment may also increase the amount of financial aid available for the younger sibling, or colleges may offer siblings a tuition discount. In the four countries that we study, sibling spillovers persist even among siblings who, due to age differences, are unlikely to attend college at the same time. In addition, universities do not charge tuition in two of the four settings we study. Thus, price effects seem unlikely to explain much of the observed spillovers.[31]

Sibling spillovers could arise if colleges offer family members an advantage in the admissions process. In the U.S., legacy effects are common because some colleges give admissions preferences to students whose family members have previously enrolled (Hurwitz (2011) noted that this practice is more frequent among colleges seeking to increase). Legacy effects are, however, unlikely to explain the spillovers we find because the target colleges we identify in the U.S. are largely public, non-flagship institutions, and legacy admissions are concentrated in more prestigious colleges. In addition, colleges in Chile, Croatia and Sweden select their students based only on their previous academic performance, so legacy effects play no role in these countries.

Second, an older sibling's enrollment in a specific college or major could affect individual preferences. Preferences may change if younger siblings experience utility gains from being close to their older

[30] The Online Appendix shows that in Chile, Croatia and Sweden, having an older sibling enroll in her target college-major does not reduce total enrollment among younger siblings.

[31] In the Online Appendix we show that the effects do not seem to be driven by location preferences either.

sibling, perhaps because they enjoy the company of their older sibling or because they think their older sibling can support them and make their college experience easier. Preferences may also be affected if older siblings are seen as role models and younger siblings are inspired by them, if siblings are competitive, or if parental pressure changes as a consequence of older sibling enrollment.

The persistence of sibling effects when there are large age differences suggests that our results are not driven by siblings enjoying each other's company, or by the benefits that may arise from attending the same campus simultaneously. In the U.S., younger siblings' four-year college enrollment rose by twice as much as enrollment in their older siblings' target college, further suggesting that this sibling proximity channel is not the main driver of our results.

The lack of effects on younger siblings' academic performance and college preparation also suggests that individual aspirations and parental pressure to apply to and enroll in college are not important drivers of our findings. If this were an important channel, we would expect to see younger siblings exerting additional effort in preparation for college. Joensen and Nielsen (2018) argue that the fact that their results (on spillovers in high school) are driven by brothers who are close in age and in academic performance is evidence that competition is driving their results. This does not appear to be the case in our setting because our results persist even among siblings with large age differences and among opposite gender siblings.

Finally, an older sibling enrolling in a specific college or college-major could affect the choice set of their younger siblings by making some options more salient or by providing information about relevant attributes of the available options.[32] Since applicants face a huge number of college and major options, both hypotheses could play an important role. An older sibling's enrollment at a particular college may generate information for parents or a younger sibling that would otherwise be costly or impossible to obtain.

Evidence on when individuals are most likely to follow their older sibling suggests that their older siblings' experiences are more relevant than the average experiences of other students on campus. Our results for Chile, Croatia and Sweden show that individuals follow their older siblings when there are both positive and negative differences between the older sibling's target and next best

[32] Hastings, Neilson, and Zimmerman (2015) and Conlon (2019) show evidence from a randomized control trial that information about earnings of graduates could potentially affect college and major choice.

options in terms of expected earnings, peer quality and first year retention rates. While we do not observe older siblings' counterfactual options in the U.S., our estimates indicate that crossing an admissions threshold moves many older siblings from two- to four-year colleges. This large change in older siblings' educational trajectories also impacts their younger siblings' choices, especially among uncertain college-goers.

Our results are consistent with individuals placing particularly high weight on their family members' college experiences because the educational success of a close relative is more salient and predictive of one's own success than more general sources of information. The fact that sibling spillovers vanish if the older sibling drops out suggests that older siblings' experiences matter, and that younger siblings update their choices accordingly. These results also suggest that some of the information transmitted between siblings is related to quality aspects that we do not measure. In line with this reasoning, recent research suggest that non-pecuniary aspects of college life matter more than labor market prospects for applicants' preferences (Wiswall and Zafar, 2014; Patnaik, Wiswall, and Zafar, 2020). It might very well be that younger siblings learn about the social life and general satisfaction of students at their older sibling's institution, and this information could be more important than information readily available about other programs.

Although these results are consistent with information transmission, we cannot rule out that part of the effects are driven by changes in younger siblings' preferences. Finding that older siblings are followed when the shocks affecting their higher education trajectories move them to better, but also to worse options may indicate that there is an intrinsic value in following the path of an older sibling. This could also explain why some of them follow their older siblings to what appear to be worse educational paths. Even though the evidence discussed in this section does not allow us to perfectly identify the mechanisms behind our findings, it suggests that information about the college experience of someone close to the applicant plays a relevant role in their college related choices. Further research is required to learn what individuals learn from the higher education experience of siblings and other close peers.

6 Conclusion

The education and earning trajectories of individuals from the same social group are highly correlated. However, it is challenging to identify whether the influence of family and social networks in important life decisions can explain part of these correlations. This paper presents causal evidence that shocks to the educational trajectories of older siblings impact relevant human capital investment decisions by their younger family members. We use rich administrative data from four countries to identify siblings and link them to detailed data on college applications and enrollment decisions. Our empirical strategy exploits admission cutoffs that generate quasi-random variation in the education trajectory of older siblings.

We show that in four very different settings—Chile, Croatia, Sweden and the United States—shocks to older siblings' higher education trajectories impact younger siblings' application and enrollment decisions in meaningful ways. Having an older sibling crossing the admission threshold of a four-year college makes younger siblings more likely to attend a four-year college as well. Older siblings also influence the institution and program that their younger siblings attend. An older sibling's admission to a college increases the younger sibling's enrollment in the same college. Similarly, an older sibling's admission to a specific college-major combination makes their younger siblings more likely to enroll in that same program. Using information on the older sibling's counterfactual option, we find that this phenomenon occurs even when the older sibling's target and counterfactual options differ significantly in expected earnings, peer quality and retention rates. However, younger siblings do not always follow their older siblings; the effects that we document disappear when the older sibling has a negative experience in college and drops out. This suggests that individuals learn from their older siblings about the institution they enroll in and about the experience that someone like them could have there.

The four countries that we study vary in size, economic development, and education institutions. The GDP per capita of Sweden and the U.S. is twice as large as that of Chile and Croatia. The share of adults with post secondary degrees varies significantly across these countries, and while colleges in Chile and the U.S. charge high tuition fees, in Croatia and Sweden they are free. Despite these differences, we consistently find that older siblings' higher education trajectories influence the application and enrollment decisions of their younger siblings. Finding consistent results across these four different settings strongly suggests that the effects that we document are not context-specific or driven by institutional details.

These results are important because they show that relatives and potentially other close peers causally influence the consequential decisions of whether to go to college, where to study and what to specialize in. The available evidence suggests that all of these margins are relevant for future earnings and life outcomes. Therefore, gaining a better understanding of what drives these decisions is critical.

These findings also shed new light on how policymakers should assess both the drivers of inequality and policies to mitigate them. Our results confirm that there is a *causal* component to the correlations we observe between the educational choices of individuals from the same social group. Especially in contexts where some groups are more likely to face barriers and negative shocks in their path to higher education, these social spillovers could amplify inequality in educational trajectories. On the other hand, our findings suggest that the effects of policies designed to mitigate this inequality could have multiplier effects through social networks. Programs that improve individuals' educational trajectories—such as financial aid, information interventions or affirmative action—will likely have larger effects than those typically estimated because they indirectly benefit younger siblings and potentially other close peers of the direct beneficiaries.

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Table I: Institutional Characteristics

	Chile (1)	Croatia (2)	Sweden (3)	US (4)
	A. Countries Characteristics			
Population	17,969,353	4,203,604	9,799,186	320,742,673
GDP per Capita	$22,688	$23,008	$48,436	$56,803
GINI Index	47.7	31.1	29.2	41.5
Human Development Index	0.84	0.827	0.929	0.917
Adults with Postsecondary Ed.	15.17%	18.30%	34.56%	39.95%
	B. University System Characteristics			
Colleges	33/60	49/49	36/36	21/3004
College-Major Combinations	1,423	564	2,421	
Tuition Fees	Yes	Yes	No	Yes
Funding for Tuition Fees	Student loans and scholarships.	Fee waiver[1].	NA	Student loans and scholarships.
Application Level	College-Major	College-Major	College-Major	College

Notes: The statistics presented in Panel A come from the World Bank (`https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD`) and from the United Nations (`http://hdr.undp.org/en/data`) websites. All statistics reported correspond to 2015 data, with the exception of the share of adults who completed a postsecondary education, which we observe in 2011. The share of adults who completed a postsecondary education is computed using the educational attainment level of individuals who were at least 25 years old in 2011.. The row "Colleges" shows the ratio of colleges that use a centralized admissions system (or which we identified to use admission cutoff rules) to the total number of colleges. In the United States the total number of colleges includes 2-year colleges. "College-Major combinations" refers to the total number of alternatives available for students through centralized admission systems in 2015.

[1] While Croatian universities charge tuition fees, first-time applicants who accept their offer receive a fee waiver. The applicant loses the fee waiver if they reject the offer.

Table II: Summary Statistics

	Chile		Croatia		Sweden		US	
	Younger Siblings (1)	All Potential Applicants (2)	Younger Siblings (3)	All Potential Applicants (4)	Younger Siblings (5)	All Potential Applicants (6)	Younger Siblings (7)	All Potential Applicants (8)
A. Demographic characteristics								
Female	0.522	0.525	0.563	0.567	0.586	0.595	0.530	0.533
Age when applying	19.028	20.059	18.880	19.158	20.486	20.823		
Household size[1]	4.632	4.322	2.790	1.925	3.104	2.950	2.250	1.288
Race: White							0.570	0.543
B. Socioeconomic characteristics								
High income[2]	0.373	0.113			0.350	0.339	0.19	0.15
Mid income[2]	0.387	0.286			0.259	0.289	0.27	0.21
Low income[2]	0.240	0.478			0.391	0.371	0.16	0.23
Parental ed: 4-year college[3]	0.434	0.207			0.571	0.519	0.650	0.595
C. Academic characteristics								
High school track: academic[4]	0.905	0.582	0.439	0.416				
Takes admission test	0.995	0.864	0.865	0.835	0.667	0.624	0.850	0.963
High school GPA score	-0.147	-0.757	268.373	265.298	0.713	0.437		
Admission test avg. score	-0.322	-0.534	312.800	286.247	0.288	-0.049	987.19	1026.095
Applicants	140,043	3,889,550	16,721	199,475	237,663	877,610	44,191	14,432,122

Notes: The table presents summary statistics for Chile, Croatia, Sweden and the United States. Columns (1), (3), (5) and (7) describe individuals in the samples used in the paper, while columns (2), (4), (6) and (8) describe all potential applicants. While in Chile, Croatia and the United States "potential applicants" include all students who register for the admission exam, in Sweden the term refers to all students applying to higher education.

[1] In Croatia and in the United States *Household Size* refers only to the number of children in the household.

[2] In Chile, the High Income category includes households with monthly incomes greater or equal than CLP 850K (USD 2,171 of 2015 PPP); the Mid Income category includes households with monthly incomes between CLP 270K - 850K; and the Low Income category includes households with monthly incomes below CLP 270K (USD 689.90 of 2015 PPP). In Sweden, the High Income category includes households in the top quintile of the income distribution; the Mid Income category includes households in quintiles 3 and 4; and the Low Income category households in quintiles 1 and 2. The average monthly disposable income in the Swedish households is USD 5,664 (2015 PPP) in the siblings sample and USD 5,265 (2015 PPP) among all applicants. In the US, low income refers to students from families earning less than $50,000 USD per year. Middle income refers to families with $50,000-$100,000 and high income refers to families with incomes above $100,000. In the US, incomes are self-reported by the students and are missing for many students.

[3] In Chile and Sweden parental education refers to the maximum level of education reached by any of the applicants' parents. In the United States it refers to the education of the mother.

[4] In Croatia, high school academic performance is only available from 2011 to 2015. This sample has 155,587 observations (the corresponding siblings sample has 8,398 observations).

Table III: Sibling Spillovers on Applications to and Enrollment in Older Sibling's Target Choice

	Older Sibling's Target College			**Older Sibling's Target College-Major**			**Older Sibling's Target Major**		
	Applies in the 1st preference (1)	**Applies in any preference** (2)	**Enrolls** (3)	**Applies in the 1st preference** (4)	**Applies in any preference** (5)	**Enrolls** (6)	**Applies in the 1st preference** (7)	**Applies in any Preference** (8)	**Enrolls** (9)
Panel A - Chile									
Older sibling enrolls	0.067***	0.076***	0.038***	0.012***	0.023***	0.006***	0.012	0.017*	-0.001
	(0.012)	(0.014)	(0.011)	(0.003)	(0.005)	(0.002)	(0.007)	(0.010)	(0.006)
Older sibling above cutoff	0.033***	0.037***	0.018***	0.006**	0.012***	0.003***	0.005	0.010*	-0.000
	(0.006)	(0.007)	(0.005)	(0.001)	(0.003)	(0.001)	(0.003)	(0.005)	(0.003)
Observations	86521	86521	86521	170886	170886	170886	106085	106085	106085
Counterfactual mean	0.222	0.447	0.132	0.019	0.064	0.012	0.079	0.179	0.054
Bandwidth	12.500	12.500	12.500	18.000	18.000	18.000	16.000	16.000	16.000
Kleibergen-Paap Wald F-statistic	5576.25	5576.25	5576.25	14765.19	14765.19	14765.19	4833.50	4833.50	4833.50
Panel B - Croatia									
Older sibling enrolls	0.075***	0.109***	0.084***	0.015***	0.036***	0.013**	0.008	0.010	0.004
	(0.019)	(0.019)	(0.018)	(0.004)	(0.009)	(0.004)	(0.007)	(0.012)	(0.006)
Older sibling above cutoff	0.063***	0.091***	0.070***	0.012***	0.030***	0.011**	0.007	0.008	0.003
	(0.016)	(0.016)	(0.015)	(0.004)	(0.007)	(0.003)	(0.005)	(0.009)	(0.005)
Observations	12950	12950	12950	36757	36757	36757	31698	31698	31698
Counterfactual mean	0.293	0.523	0.253	0.022	0.111	0.017	0.059	0.218	0.054
Bandwidth	80.000	80.000	80.000	80.000	80.000	80.000	80.000	80.000	80.000
Kleibergen-Paap Wald F-statistic	6459.56	6459.56	6459.56	14512.30	14512.30	14512.30	10158.25	10158.25	10158.25
Panel C - Sweden									
Older sibling enrolls	0.122***	0.132***	0.049***	0.020***	0.031***	0.005***	0.000	-0.002	-0.001
	(0.008)	(0.011)	(0.005)	(0.002)	(0.005)	(0.001)	(0.006)	(0.009)	(0.004)
Older sibling above cutoff	0.033***	0.035***	0.013***	0.006***	0.009***	0.001***	0.000	-0.001	0.000
	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.000)	(0.002)	(0.002)	(0.001)
Observations	378466	378466	378466	482220	482220	482220	355885	355885	355885
Counterfactual mean	0.087	0.206	0.032	0.011	0.053	0.003	0.049	0.101	0.016
Bandwidth	0.360	0.360	0.360	0.386	0.386	0.386	0.389	0.389	0.389
Kleibergen-Paap Wald F-statistic	7215.227	7215.227	7215.227	10406.511	10406.511	10406.511	6643.373	6643.373	6643.373

Notes: "Applies in the 1st preference" looks at the probability that the younger sibling ranks the target choice of the older sibling in her/his first preference; "Applies in any preference" looks at the probability of ranking the older sibling's target choice in any preference; and "Enrolls" looks at the probability of enrolling in the target choice of the older sibling. The first row of each panel presents 2SLS estimates in which older siblings' enrollment is instrumented with them being above an admission cutoff. The second row presents reduced form estimates. All the specifications in the table control for a linear polynomial of older siblings' application score centered around the admission cutoff of the target choice. Fixed effects for older siblings' application year, admission cutoffs and younger siblings' birth year are included. Among the three outcomes in each sample, we use the smallest Calonico et al. (2014) optimal bandwidth. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Table IV: Sibling Spillovers on College Choice and College Quality in the US

	College type		College quality		Price, location		Older Sibling's Target College	
	4-year college (1)	2-year college (2)	B.A. completion rate (3)	Peer quality (Z-score) (4)	Net price (000s) (5)	50+ miles from home (6)	Younger sibling applies (7)	Younger sibling enrolls (8)
Panel A - All Students								
Older sibling enrolls	0.230*	-0.002	0.180**	0.316**	2.263	0.135	0.279**	0.172***
	(0.132)	(0.114)	(0.080)	(0.148)	(2.321)	(0.127)	(0.103)	(0.054)
Counterfactual mean	0.38	0.20	0.30	-0.21	8.74	0.21	0.10	0.01
Panel B - Uncertain college-goers								
Older sibling enrolls	0.531**	0.055	0.473***	0.699***	11.245***	0.429**	0.271	0.257***
	(0.248)	(0.214)	(0.150)	(0.260)	(4.168)	(0.221)	(0.179)	(0.099)
Counterfactual mean	0.09	0.09	0.01	-0.67	-0.28	-0.04	0.13	-0.08
Panel C - Probable college-goers								
Older sibling enrolls	0.049	-0.033	0.011	0.091	-2.893	-0.066	0.291**	0.131*
	(0.159)	(0.139)	(0.098)	(0.186)	(2.968)	(0.162)	(0.131)	(0.068)
Counterfactual mean	0.57	0.25	0.49	0.08	14.07	0.41	0.07	0.06

Notes: Each coefficient is a 2SLS estimate of the impact of an older sibling's enrollment in her/his target college on younger siblings' college choices, using admissibility as an instrument. Each estimate comes from a local linear regression with a bandwidth of 93 SAT points, a donut specification that excludes observations on the threshold, and fixed effects for each combination of older sibling's cohort, younger sibling's cohort, and older sibling's target college. The first panel includes all students, while the Panels B and C divide the sample into those in the bottom third and top two-thirds of the distribution of predicted four-year college enrollment. College quality is measured by the fraction of students starting at that college who complete a B.A. anywhere within six years (column 3) and the mean standardized PSAT score of students at that college (column 4). Also listed below each coefficient is the predicted value of the outcome for control compliers. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Table V: Sibling Spillovers on Younger Siblings' Applications by Differences between Older Siblings' Target and Next Best Options

	Chile			**Croatia**	**Sweden**		
	Effect of older siblings' enrollment on younger siblings' applications by differences in:						
	Expected earnings (USD 000) (1)	Peer quality (z-score) (2)	First year retention rate (3)	Peer quality (z-score) (4)	Expected earnings (USD 000) (5)	Peer quality (z-score) (6)	First year retention rate (7)
	Panel A - Younger Sibling Applies to Older Sibling's Target College						
Older sibling enrolls (ΔX in 1st quartile)	0.096***	0.146***	0.083***	0.064*	0.098***	0.109***	0.115***
	(0.028)	(0.030)	(0.028)	(0.033)	(0.025)	(0.021)	(0.023)
Older sibling enrolls (ΔX in 2nd quartile)	0.117***	0.102***	0.102***	0.146***	0.129***	0.097***	0.103***
	(0.027)	(0.026)	(0.027)	(0.031)	(0.021)	(0.020)	(0.020)
Older sibling enrolls (ΔX in 3rd quartile)	0.091***	0.096***	0.105***	0.122***	0.117***	0.091***	0.089***
	(0.027)	(0.026)	(0.025)	(0.031)	(0.022)	(0.022)	(0.021)
Older sibling enrolls (ΔX in 4th quartile)	0.090***	0.082***	0.112***	0.105***	0.168***	0.123***	0.106***
	(0.029)	(0.026)	(0.027)	(0.032)	(0.028)	(0.025)	(0.024)
Observations	32987	32987	32987	9610	147190	167290	159146
Kleibergen-Paap F-statistic	722.509	744.566	740.276	1089.054	613.193	676.879	673.860
Counterfactual mean	0.443	0.443	0.443	0.502	0.221	0.220	0.222
	Panel B - Younger Sibling Applies to Older Sibling's Target College-Major						
Older sibling enrolls (ΔX in 1st quartile)	0.020**	0.018**	0.030***	0.037***	0.024**	0.027***	0.023**
	(0.009)	(0.009)	(0.009)	(0.011)	(0.011)	(0.010)	(0.010)
Older sibling enrolls (ΔX in 2nd quartile)	0.022***	0.017**	0.011	0.030***	0.040***	0.023**	0.016*
	(0.008)	(0.008)	(0.008)	(0.012)	(0.010)	(0.009)	(0.009)
Older sibling enrolls (ΔX in 3rd quartile)	0.012	0.018**	0.018**	0.040***	0.035***	0.017*	0.027***
	(0.008)	(0.008)	(0.008)	(0.012)	(0.010)	(0.009)	(0.009)
Older sibling enrolls (ΔX in 4th quartile)	0.018**	0.024***	0.020**	0.039***	0.026**	0.028***	0.026**
	(0.009)	(0.009)	(0.009)	(0.013)	(0.012)	(0.010)	(0.010)
Observations	81849	81849	81849	32288	214143	248297	230709
F-statistic	2384.614	2437.617	2439.986	3137.876	1151.517	1280.638	1262.027
Counterfactual mean	0.072	0.072	0.072	0.112	0.067	0.063	0.062

Notes: We investigate how the probability of applying to an older sibling's target alternative changes with enrollment and with quality differences between the older sibling's target and next-best options. Quality is measured in terms of expected earnings, peer quality and first year retention rates. Differences in these variables between older siblings' target and next best options are classified in four quartiles. The effect of an older sibling's enrollment is allowed to be different in each quartile. The reported specifications use the same set of controls and bandwidths as the 2SLS specifications described in Table III. In addition, we include next-best options fixed effects. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Table VI: Sibling Spillovers on Younger Siblings' Application by Older Siblings' Target Option Characteristics

	Chile			Croatia	Sweden		
	Effect of older siblings' enrollment on younger siblings' applications by target option's:						
	Expected earnings (USD 000) (1)	Peer quality (z-score) (2)	First year retention rate (3)	Peer quality (z-score) (4)	Expected earnings (USD 000) (5)	Peer quality (z-score) (6)	First year retention rate (7)
Panel A - Younger Sibling Applies to Older Sibling's Target College							
Older sibling enrolls (X in 1st quartile)	0.095***	0.087**	0.052*	0.058*	0.156***	0.118***	0.103***
	(0.030)	(0.042)	(0.028)	(0.033)	(0.032)	(0.031)	(0.026)
Older sibling enrolls (X in 2nd quartile)	0.058***	0.082***	0.038	0.156***	0.109***	0.044*	0.115***
	(0.029)	(0.029)	(0.027)	(0.033)	(0.025)	(0.025)	(0.022)
Older sibling enrolls (X in 3rd quartile)	0.111***	0.061***	0.102***	0.104***	0.101***	0.123***	0.095***
	(0.028)	(0.025)	(0.026)	(0.035)	(0.022)	(0.022)	(0.021)
Older sibling enrolls (X in 4th quartile)	0.056***	0.086***	0.097***	0.119***	0.116***	0.115***	0.110***
	(0.021)	(0.021)	(0.022)	(0.038)	(0.021)	(0.019)	(0.021)
Observations	39960	39960	39960	9610	169619	178814	175951
Kleibergen-Paap F-statistic	824.637	626.324	926.147	1098.798	588.205	651.385	723.051
Counterfactual mean	0.444	0.444	0.444	0.502	0.219	0.220	0.220
Panel B - Younger Sibling Applies to Older Sibling's Target College-Major							
Older sibling enrolls (X in 1st quartile)	0.015*	0.023**	0.023***	0.046***	0.022*	0.020	0.028**
	(0.009)	(0.011)	(0.008)	(0.013)	(0.013)	(0.013)	(0.011)
Older sibling enrolls (X in 2nd quartile)	0.011	0.022**	0.017**	0.016	0.024**	0.012	0.026***
	(0.008)	(0.009)	(0.008)	(0.012)	(0.011)	(0.011)	(0.009)
Older sibling enrolls (X in 3rd quartile)	0.028***	0.014*	0.024***	0.036**	0.033***	0.026***	0.021**
	(0.008)	(0.008)	(0.008)	(0.014)	(0.010)	(0.010)	(0.009)
Older sibling enrolls (X in 4th quartile)	0.020***	0.023***	0.017**	0.047***	0.030***	0.029***	0.021**
	(0.007)	(0.007)	(0.008)	(0.014)	(0.010)	(0.009)	(0.010)
Observations	97321	97321	97321	32228	247960	264527	256565
Kleibergen-Paap F-statistic	2501.594	1819.772	2883.727	3046.997	1002.833	1090.406	1340.660
Counterfactual mean	0.073	0.073	0.073	0.112	0.065	0.063	0.063

Notes: We investigate how the probability of applying to older sibling's target choice changes depending on older siblings' enrollment and on the quality of her target option. Quality is measured in terms of expected earnings, peer quality and first year retention rates. Older siblings' target options are classified in four quartiles in each of these dimensions. The effect of an older sibling's enrollment is allowed to differ along these quartiles. The reported specifications use the same set of controls and bandwidths as the 2SLS specifications described in Table III. In addition, we include next-best option fixed effects. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Table VII: Sibling Spillovers on Applications to College and College-Major by Age Difference and Gender

	Younger sibling applies to any 4-year college	**Younger sibling applies to older sibling's target college**				**Younger sibling applies to older sibling's target college-major**		
	US	CHI	CRO	SWE	US	CHI	CRO	SWE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Panel A: Interaction with $\mathbb{1}$(Age Difference between Siblings ≥ 5)						
Older sibling enrolls	0.217*	0.092***	0.109***	0.141***	0.268***	0.025***	0.039***	0.038***
	(0.130)	(0.015)	(0.020)	(0.011)	(0.102)	(0.005)	(0.009)	(0.006)
Older sibling enrolls × Age diff. ≥ 5	0.136	-0.035***	0.000	-0.019**	0.104	-0.004	-0.018	-0.016***
	(0.142)	(0.011)	(0.026)	(0.010)	(0.107)	(0.004)	(0.013)	(0.004)
Observations	44190	86364	12950	378446	44190	170570	36756	482220
Kleibergen-Paap Wald F-statistic	64.892	2767.580	3230.667	3562.527	64.892	7330.470	7225.706	5147.083
		Panel B: Interaction with $\mathbb{1}$(Siblings are of the Same Gender)						
Older sibling enrolls = 1	0.310**	0.070***	0.114***	0.129***	0.304***	0.017***	0.026**	0.032***
	(0.137)	(0.016)	(0.022)	(0.012)	(0.106)	(0.005)	(0.009)	(0.006)
Older sibling enrolls × Same gender = 1	-0.152**	0.011	-0.007	0.007	-0.052	0.011***	0.023*	0.008
	(0.071)	(0.012)	(0.020)	(0.010)	(0.056)	(0.004)	(0.009)	(0.005)
Observations	44190	86521	12950	378446	44190	170886	36757	482220
Kleibergen-Paap Wald F-statistic	65.114	2788.470	3229.534	3607.870	65.114	7383.02	7220.184	5204.123

Notes: The reported specifications use the same set of controls and bandwidths as the 2SLS specifications described in Tables IV and III. In addition, they include an interaction between the treatment and a dummy variable that indicates if siblings are 5 or more years apart (Panel A) or between the treatment and a dummy variable that indicates if siblings are of the same gender (Panel B). In both cases the variable defining the interaction is also included as control. Younger siblings are counted as applying to the same alternative as their older siblings if they include that alternative at any rank in their application. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Table VIII: Sibling Spillovers on College and College-Major Choice by Older Sibling's Dropout

	Any 4-year College	Older Sibling's Target College			Older Sibling's Target College-Major	
	US	CHI	SWE	US	CHI	SWE
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A - Younger Sibling Applies to Target Alternative						
Older sibling enrolls	0.454***	0.089***	0.180***	0.448***	0.020***	0.050***
	(0.123)	(0.018)	(0.015)	(0.101)	(0.006)	(0.007)
Older sibling enrolls $\times \mathbb{1}$(Drops out)	-0.505***	-0.129***	-0.108***	-0.049	-0.036***	-0.042***
	(0.087)	(0.020)	(0.014)	(0.071)	(0.006)	(0.006)
Observations	37330	49183	359300	37330	99104	457505
Kleibergen-Paap Wald F-statistic	48.875	1950.41	2450.027	48.875	5444.24	3521.871
Panel B - Younger Sibling Enrolls in Target Alternative						
Older sibling enrolls	0.508***	0.058***	0.064***	0.183***	0.008***	0.008***
	(0.130)	(0.014)	(0.007)	(0.052)	(0.003)	(0.002)
Older sibling enrolls $\times \mathbb{1}$(Drops out)	-0.618***	-0.085***	-0.032***	0.007	-0.014***	-0.006***
	(0.091)	(0.014)	(0.006)	(0.037)	(0.003)	(0.002)
Observations	37330	49183	359300	37330	99104	457505
Kleibergen-Paap Wald F-statistic	48.875	1950.41	2450.027	48.875	5444.24	3521.871

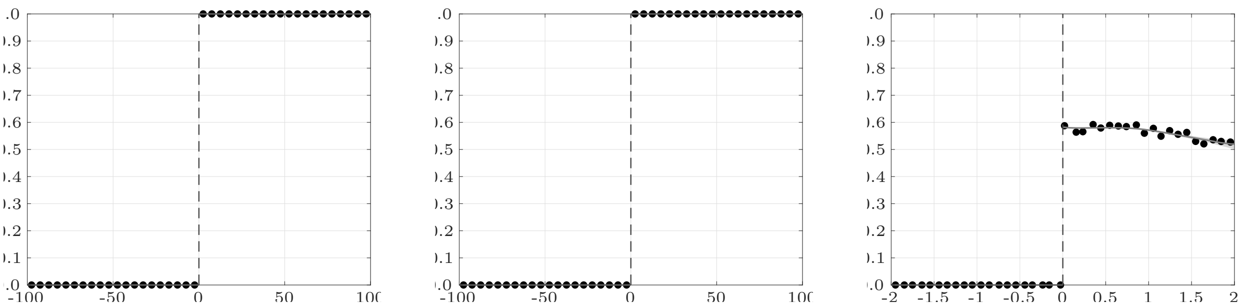
Notes: The reported specifications use the same set of controls and bandwidths as the 2SLS specifications described in Tables IV and III. In addition, they include an interaction between the treatment and a dummy variable that takes value 1 if the older sibling drops out after the first year. This dummy variable is also included as a control. We exclude siblings that are less than 2 years apart in age. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Table IX: Sibling Spillovers on Academic Performance

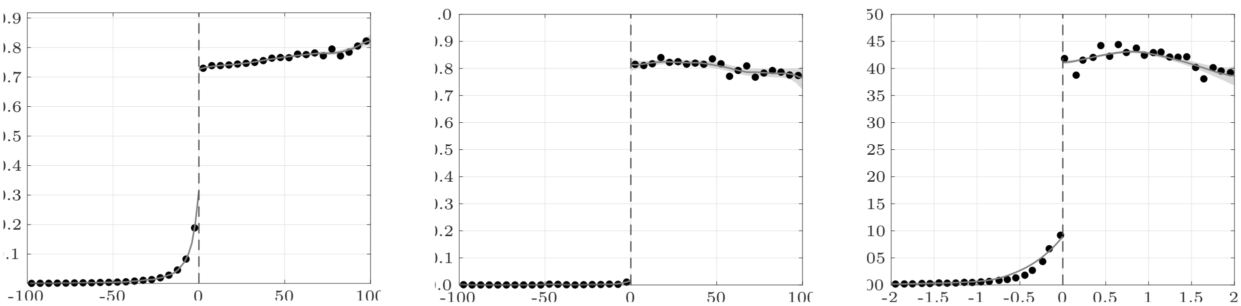
	High school GPA (1)	Takes an admission exam (2)	Average score on admissions exam (3)	Applies to college (4)
		Panel A - Chile		
Older sibling enrolls	-0.009	0.001	-0.011	-0.002
	(0.019)	(0.001)	(0.011)	(0.005)
Observations	170,886	170,886	170,886	170,886
Counterfactual mean	-0.170	0.995	-0.240	0.930
Kleibergen-Paap F-statistic	14765.190	14765.190	14765.190	14765.190
		Panel B - Croatia		
Older sibling enrolls	-0.043	-0.013	-0.054	-0.008
	(0.045)	(0.017)	(0.043)	(0.009)
Observations	12,443	12,443	10,233	36,757
Counterfactual mean	-0.030	0.810	-0.035	0.866
Kleibergen-Paap F-statistic	4498.481	4498.481	3728.910	14512.30
		Panel C - Sweden		
Older sibling enrolls	0.011	-0.031***	0.068**	-0.009
	(0.022)	(0.011)	(0.030)	(0.010)
Observations	421268	482220	227976	482220
Counterfactual mean	0.218	0.494	0.040	0.654
F-statistic	9714.124	10406.511	6660.104	10406.511
		Panel D - United States		
Older sibling enrolls		0.073	46.9	0.159
		(0.096)	(43.0)	(0.125)
Observations		44,190	37,554	44,190
Counterfactual mean		0.830	951.000	0.545
Kleibergen-Paap F-statistic		129.730	120.758	129.730

Notes: The table presents 2SLS estimates for the effect of older siblings' enrollment in their preferred college-major (Chile, Croatia and Sweden) or college (United States) on younger siblings' high school GPA (column 1), probability of taking the admission exam (column 2), average performance on the admission exam (column 3) and applying to college (column 4). For the U.S., (4) looks at the number of applications submitted. The reported specifications use the same set of controls and bandwidths as the 2SLS specifications described in Table IV and Table III. Standard errors clustered at the family level are reported in parenthesis. *p-value<0.1 **p-value<0.05 ***p-value<0.01.

Figure I: Older Siblings' Admission and Enrollment Probabilities in Target Major-College at the Admission Cutoff (First Stage)



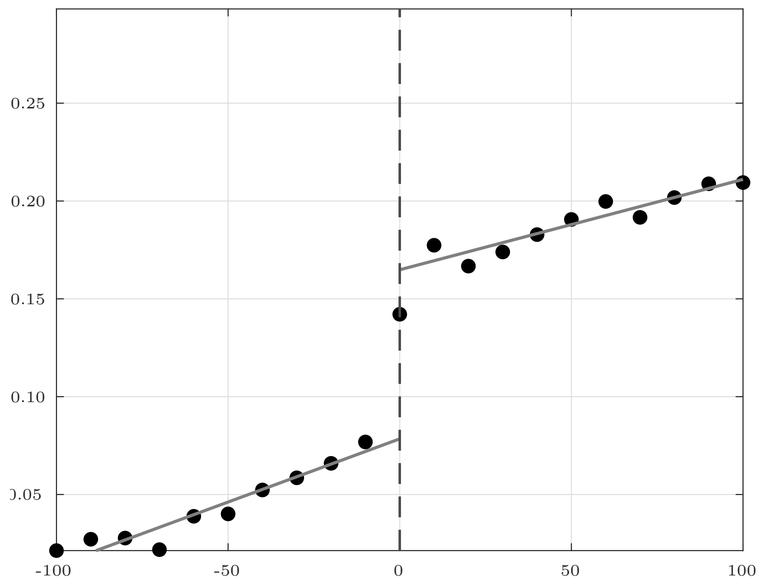
(a) Admission - Chile (b) Admission - Croatia (c) Admission - Sweden



(d) Enrollment - Chile (e) Enrollment - Croatia (f) Enrollment - Sweden

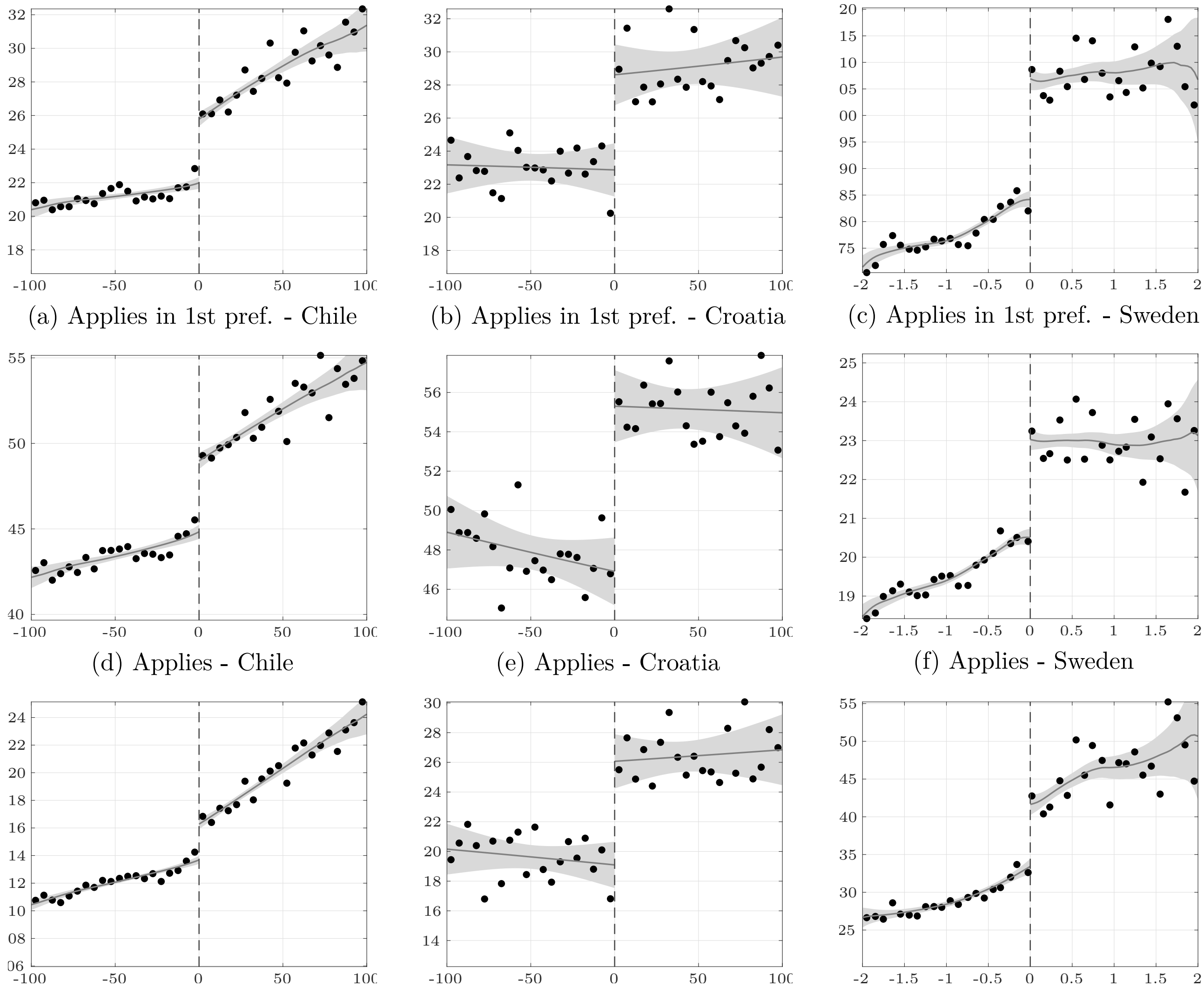
This figure illustrates older siblings' admission and enrollment probabilities around the admission cutoffs of their target majors in Chile, Croatia and Sweden. Figures (a) and (d) illustrate these probabilities for Chile, figures (b) and (e) for Croatia and figures (c) and (f) for Sweden. Gray lines and the shadows in the back of them represent local linear polynomials and 95% confidence intervals. Black dots represent sample means of the dependent variable at different values of older siblings' own application score.

Figure II: Older Siblings' Enrollment Probability in in the Target College at the Admission Cutoff (First Stage)



This figure illustrates older siblings' enrollment probability in their target college around the admission cutoffs in the United States. Gray lines represent local linear polynomials. Black dots represent sample means of the dependent variable at different values of older siblings' SAT score.

Figure III: Probabilities of Applying and Enrolling in Older Sibling's Target College



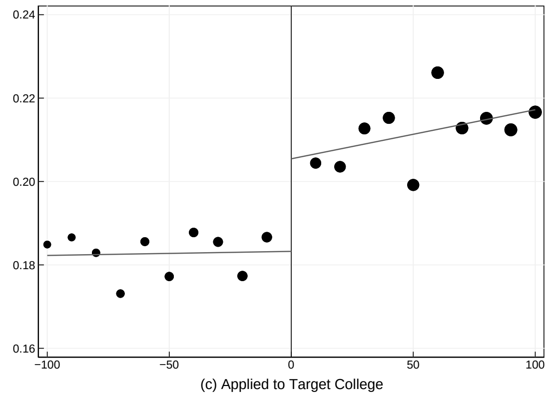
(a) Applies in 1st pref. - Chile (b) Applies in 1st pref. - Croatia (c) Applies in 1st pref. - Sweden

(d) Applies - Chile (e) Applies - Croatia (f) Applies - Sweden

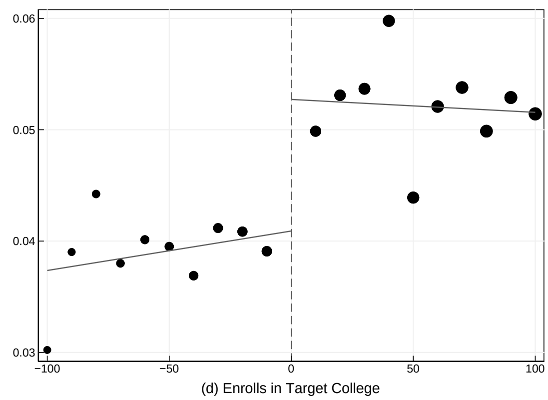
(g) Enrolls - Chile (h) Enrolls - Croatia (i) Enrolls - Sweden

This figure illustrates the probabilities that younger siblings apply to and enroll in the target college of their older siblings in Chile, Croatia and Sweden. Figures (a), (d) and (g) illustrate the case of Chile, figures (b), (e) and (h) the case of Croatia, while figures (c), (f) and (i) the case of Sweden. Gray lines and the shadows in the back of them correspond to local polynomials of degree 1 and 95% confidence intervals. Black dots represent sample means of the dependent variable at different values of older sibling's admission score.

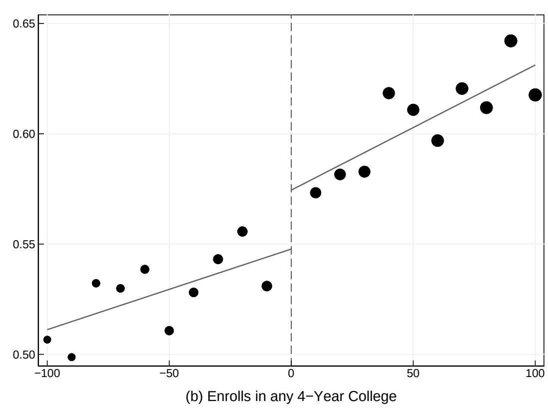
Figure IV: Probabilities of Enrolling in any 4-year College and in the Older Sibling's Target College in the US



(a) Applies to Target College



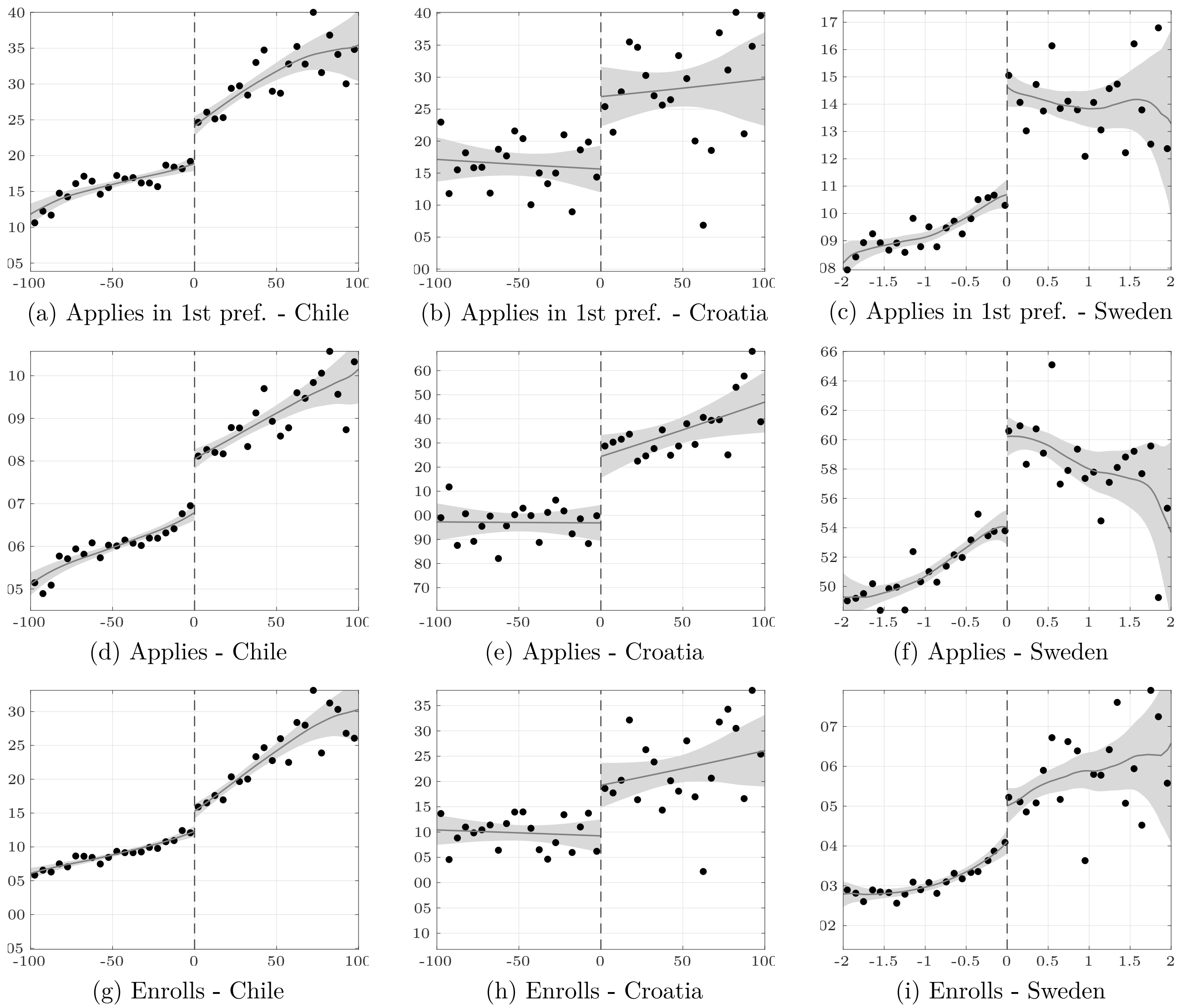
(b) Enrolls in Target College



(c) Enrolls in any 4-year College

This figure present reduced form results for the US. Panel (a) illustrates the probability that younger siblings apply to the target college of their older siblings, panel (b) that they enroll in that target college, and panel (c) that they enroll in any 4-year college . Gray lines correspond to local polynomials of degree 1. Black dots represent sample means of the dependent variable at different values of older sibling's admission score.

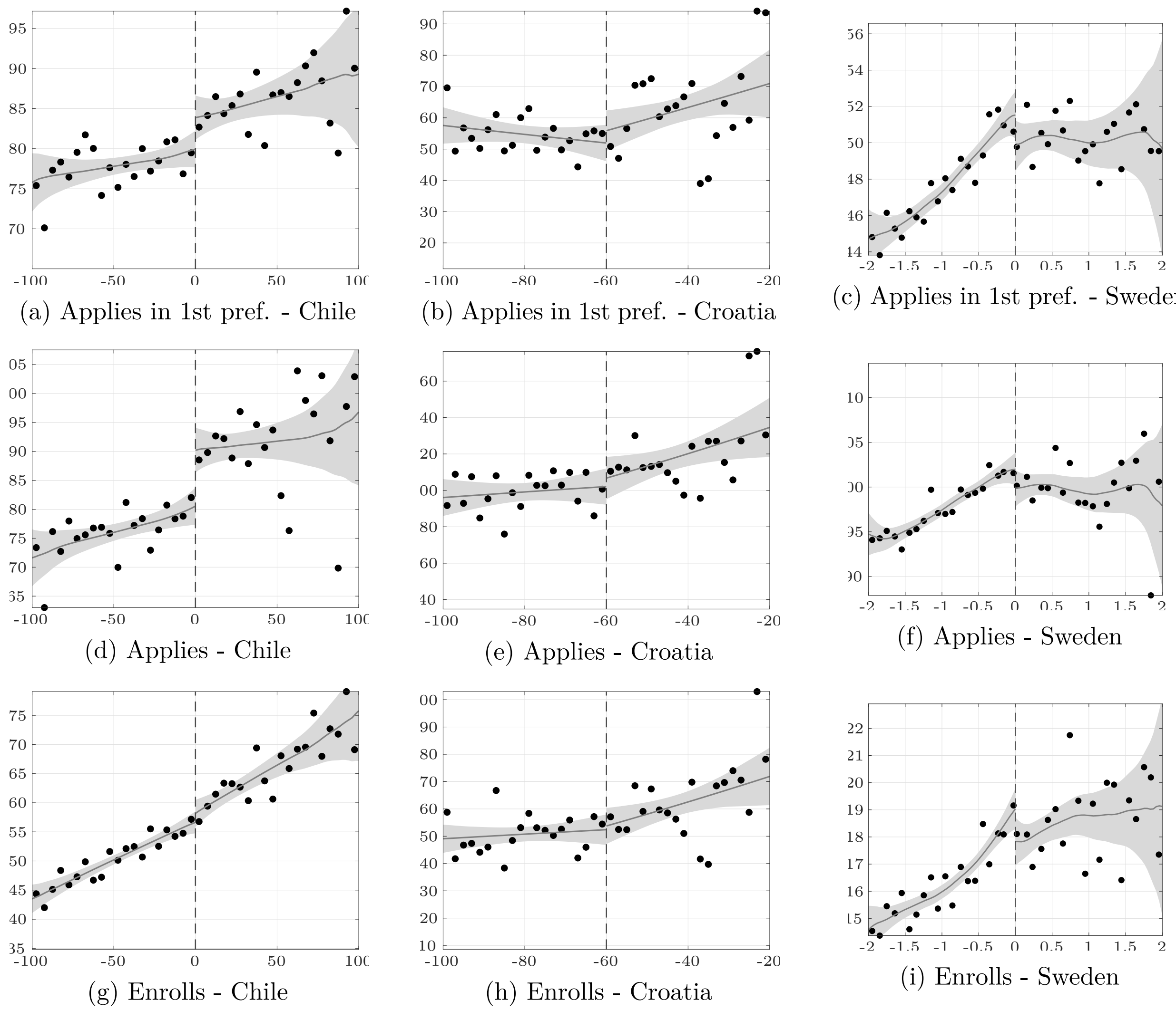
Figure V: Probabilities of Applying and Enrolling in Older Sibling's Target College-Major



(a) Applies in 1st pref. - Chile
(b) Applies in 1st pref. - Croatia
(c) Applies in 1st pref. - Sweden
(d) Applies - Chile
(e) Applies - Croatia
(f) Applies - Sweden
(g) Enrolls - Chile
(h) Enrolls - Croatia
(i) Enrolls - Sweden

This figure illustrates the probabilities that younger siblings apply to and enroll in the target college-major of their older siblings in Chile, Croatia and Sweden. Figures (a), (d) and (g) illustrate the case of Chile, figures (b), (e) and (h) the case of Croatia, while figures (c), (f) and (i) the case of Sweden. Gray lines and the shadows in the back of them correspond to local polynomials of degree 1 and 95% confidence intervals. Black dots represent sample means of the dependent variable at different values of older sibling's admission score.

Figure VI: Probabilities of Applying and Enrolling in Older Sibling's Target Major



(a) Applies in 1st pref. - Chile
(b) Applies in 1st pref. - Croatia
(c) Applies in 1st pref. - Sweden
(d) Applies - Chile
(e) Applies - Croatia
(f) Applies - Sweden
(g) Enrolls - Chile
(h) Enrolls - Croatia
(i) Enrolls - Sweden

This figure illustrates the probabilities that younger siblings apply to and enroll in the target major of their older siblings in Chile, Croatia and Sweden. Figures (a), (d) and (g) illustrate the case of Chile, figures (b), (e) and (h) the case of Croatia, while figures (c), (f) and (i) the case of Sweden. Gray lines and the shadows in the back of them correspond to local polynomials of degree 1 and 95% confidence intervals. Black dots represent sample means of the dependent variables at different values of older siblings' admission score.