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From Epidemic to Pandemic: Effects of the COVID-19 Outbreak on High School Program Choices in Sweden

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ABSTRACT

From Epidemic to Pandemic: Effects of the COVID-19 Outbreak on High School Program Choices in Sweden*

We study whether the onset of the COVID-19 crisis affected the program choices of high school applicants in Sweden. Our analysis exploits the fact that the admission process consists of two stages: a preliminary round in which applicants initially rank programs in order of preference and a final round in which they can alter their preliminary rankings. In 2020, the timing of the two rounds happened to provide a unique pre- and post-crisis snapshot of applicants' field-of-study choices. Using school-level data on applicants' top-ranked programs for all admission rounds between 2016 and 2020, we implement a difference-in-differences method to identify the immediate effect of the crisis on demand for programs. We find no change in demand for academic programs, but a decline in top-ranked applications to some of the vocational programs. The declines are most pronounced and robust for several service-oriented programs, in particular those related to the hotel and restaurant sector, which was the most adversely affected industry during the crisis. This finding suggests that labor market considerations influence the study choices made by relatively young students.

JEL Classification: I20, J24

Keywords: COVID-19, business cycle, human capital investment, field of study

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1 Introduction

The economic disruptions caused by the COVID-19 pandemic have been distributed unequally across age groups. Sectors that typically employ young workers were hit the hardest, and there is evidence that employment losses have disproportionately been borne by younger people (Eurofound, 2021). As a result, the crisis led to a decrease in students' outlook for financial security and may have affected their expectations about the employment prospects of different occupations, in turn altering their demand for different fields of study. Survey evidence suggests that college students were indeed quick to reconsider their education decisions as economic disruptions became evident during the early stages of the pandemic: Aucejo et al. (2020) found that, as early as mid-2020, US college students switched from lower- to higher-paying fields.

The existing literature on how economic disruptions affect field-of-study choices primarily focuses on higher education levels. In contrast, we consider the effect of the COVID-19 pandemic on program choices at the high school level, and to the best of our knowledge, our work is unique in this respect. This is an important contribution because the choice of high school major can have significant consequences for adult earnings and labor market prospects (Altonji et al., 2012; Dahl et al., 2021; SCB, 2017). Moreover, a very large percentage of individuals in a birth cohort make field-of-study-choices in high school,¹ while a much smaller subset of the population with above-average socio-economic status makes this choice at the college level. Our evidence comes from the Swedish context, where high school students apply to field-specific programs that can be characterized as either academic (e.g., Natural Science) or vocational (e.g., Building & Construction) in nature. However, our results have broader relevance, given that high school students make similar choices in the majority of other European countries.²

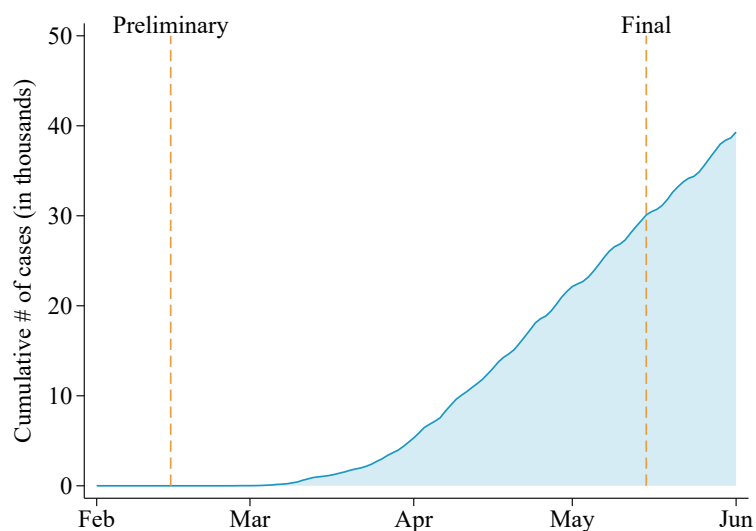
To study how program demand changed in response to the COVID-19 crisis, we use a difference-in-differences strategy exploiting the fact that admission to Swedish high schools consists of two rounds. In the preliminary round, applicants rank their

¹In Sweden, where our study is based, around 90% of a birth cohort progress on to upper secondary education.

²Despite differences in the design of education systems, all member states of the European Union offer possibilities for both general (academic) education and vocational programs at the upper secondary level. Out of all students who are enrolled in upper secondary education in the European Union, roughly 52% were enrolled in more general academic programs, while 48% attended vocational tracks (Eurostat, 2021).

preferences for specific programs and submit their initial choices to a central admission authority by mid-February. After preliminary admission decisions are released, students have until mid-May to alter their preference rankings for the final admission round. As shown in Figure 1, the timeline of the two rounds provides unique pre- and post-crisis snapshots of the 2020 admission cohort’s study choices. It is essential for our identification strategy that the crisis had not yet hit Sweden and was still considered an epidemic in Asia when applicants submitted their initial preference rankings. However, by the final admission round, the epidemic had turned into a pandemic and had spread to and within Sweden. This allows us to identify the immediate effect of the crisis on program demand by estimating the change in the number of top-ranked applications to specific programs between the admission rounds in 2020 as compared to the change between the rounds in the previous year.

Figure 1: Cumulative COVID-19 cases in 2020 and timeline of the admission rounds.



Notes: Data comes from the Public Health Agency of Sweden. The vertical lines indicate the two admission rounds.

In order to conduct our study, we contacted the high school admission centers in Sweden and collected data for almost 700 schools, covering more than 90% of applicants nationwide. The data set includes school-level data for both the preliminary and final admission rounds in 2020, as well as several years before the crisis. An advantage

of our data is that we observe top-ranked choices on applications: we argue that this measure captures students' demand for programs more accurately than admission or enrollment outcomes, which might be constrained by the availability of places. In addition, we expand our data set by harmonizing school identifier codes and linking our data set to publicly available data on time-varying school-level characteristics of the student body and staff from the Swedish National Agency of Education. In our main model, we exploit variation within a school over rounds and time and include school fixed effects as well as time-varying school-level controls that may affect the desirability of schools.

Our results show that the pandemic led to a drop in top-ranked applications to some of the vocational programs, whereas none of the academic programs were affected. For the Hotel & Restaurant program and the Child & Recreation program, the effect is robust throughout and non-trivial, amounting to 8% and 6%, respectively, in relation to the mean number of applications to these programs. There is also evidence of a slightly smaller, and less robust, negative effect for the Business & Administration program. In contrast to papers showing that college enrollment increases in response to recessions, there is no indication that students shift towards programs that tend to lead to higher-paying jobs or to programs that grant eligibility to university studies after finishing high school. The drop in top-ranked applications to the Hotel & Restaurant program is in line with responses to sector-specific shocks, and reflects that the decline in employment and vacancies was largest in the hotel and restaurant sector.³

Our results are robust when we estimate our model without fixed effects or controls at the school level, suggesting that changes in the desirability of schools are unlikely to bias our results. Importantly, we can use our main model to estimate whether the pandemic led to adjustments on the supply side. Using the difference in the number of offered places per program between rounds as an outcome, we show that, with the exception of the Business & Administration program, distortions in the supply of available places do not explain our findings. There is also no evidence that distortions in the internship component of vocational programs explain our results.⁴

Our paper contributes to a large literature that is concerned with how economic downturns affect human capital decisions. With regard to the length of education, there

³According to Statistics Sweden, employment in this sector reached a low in April 2020, shortly before final applications had to be submitted.

⁴Our findings are robust to excluding applications to apprenticeship programs, which have a considerably higher share of on-the-job training.

is ample evidence of the existence of a countercyclical pattern with regard to high school and college enrollment in the US and the UK (see, for instance, [Betts and McFarland, 1995](#); [Card and Lemieux, 2001](#); [Clark, 2011](#); [Rice, 1999](#)), even though the strength of the relationship varies widely. For Norway, [Reiling and Strøm \(2014\)](#) find that completion rates at the upper secondary level are countercyclical, a relationship that is strongest for students in vocational tracks. There is also a growing literature showing that students alter their choice of college majors to higher-paying fields when faced with a depressed labor market ([Blom et al., 2021](#); [Bradley, 2012](#); [Liu et al., 2018](#)). However, other studies find that sector-specific shocks can deter college students from generally well-paid or prestigious majors in the affected sectors ([Han and Winters, 2020](#); [Weinstein, 2020](#)). Our study is one of the few that provides results for students who apply to vocational programs and generally come from families with a lower socioeconomic background. There is little direct evidence on how vocational field-of-study choices are affected with the exception of [Acton \(2021\)](#), who shows that local occupation-specific employment variations affect related field-of-study choices at the community college level and that students tend to switch between vocational programs that require similar skills.

The rest of the paper is structured as follows: Section [2](#) provides key institutional details about the high school admission process and the early impact of the COVID-19 crisis in Sweden. Section [3](#) presents our self-collected data and empirical model. Section [4](#) presents our main results, including a discussion of the parallel trends assumption. Section [5](#) reports several robustness checks of the main findings. Section [6](#) concludes the study.

2 Background

2.1 Admission to Swedish high school

In Sweden, compulsory schooling lasts through ninth grade, when students are around 16 years old. After completing ninth grade, students can choose to apply for different programs at high school. All high school programs last for three years and are either academic or vocational in nature. Table [A.1](#) in the Appendix lists the 18 national programs that currently exist, though their availability differs somewhat across regions. There are 12 different vocational programs that students can apply to (e.g., Child & Recreation,

Vehicle & Transport, or Hotel & Tourism), as well as six academic programs (e.g., Humanities, Natural Science, or Social Science). Academic programs aim to prepare students for university studies, while vocational programs aim to prepare students for specific occupations and contain a 15-week (unpaid) internship with an employer. However, given that students fulfill certain course requirements, it is even possible to obtain the qualification needed to study at a university through the vocational programs. Many of the vocational programs are also offered as apprenticeship programs. Compared to the ordinary vocational programs, at least half of the education in these programs consists of on-the-job training in close cooperation between employers and schools. During our period of study (2016–2020), around 12% of students in vocational programs were enrolled in apprenticeships.

Admission to the various high school programs is handled centrally by local admission centers.⁵ The admission system is grade-based and organized as a two-stage process consisting of a preliminary and final round. Application in the preliminary round is not obligatory but highly encouraged because high schools use the number of first-round applicants in order to plan the resources for the following school year; if there are too few applicants to a program, it may be decided that the program will not take place that year. In addition, students gain understanding about their possibilities to be accepted to a program with their current grades.

Applications for preliminary admission are usually submitted between late January and mid-February depending on the region in which students apply. At that point, students choose and rank each combination of school and program that they are interested in. Students are typically notified of preliminary admission decisions between late March and mid-April. The preliminary decisions are based on students' most recent grades at the time, that is, grades from the fall semester of ninth grade.⁶ Students are admitted to their highest-ranked option for which they can qualify based on grades and, in some instances, certain course requirements. Students who get accepted to a lower-ranked choice are listed as reserves for higher-ranked programs but can choose whether they want to be on the reserve list for each respective program. Along with their

⁵Students can apply to programs in multiple regions, but they submit only one application during the admission process. Applications are always processed by the local admission center covering the municipality in which a student resides.

⁶If applicants have already completed ninth grade at the time of application, then their final grades from ninth grade are used already in the preliminary admission round.

preliminary admission decisions, students also receive information on the preliminary grade cutoffs required for admission to different programs.

The second and final admission round takes place between April and mid-May. Students can opt to leave their initial preference ranking as is or alter their choices by adding new programs, deleting programs, or changing the ranking of their choices. The results of the final admission round are usually made available around the end of June or beginning of July. At that time, students learn what programs they are admitted to based on their final grades from compulsory school. They can also see whether they are listed as reserves for a higher-ranked program and the necessary grade cutoffs for admission. Upon receiving the final admission results, students have to decide whether to accept the offered slot or whether they want to be considered for a program that they are currently on the reserve list for. Slots that become available after the final admission are reallocated to students highest up on the reserve list.

2.2 Early impact of COVID-19 in Sweden

In a press release from mid-February 2020, the Swedish Public Health Agency's assessment was that the new coronavirus was predominantly contained in China and that the risk of community spread in Sweden was very low.⁷ Only one month later, the agency overturned its previous assessment, and the first restrictions on public gatherings were implemented.⁸ While international news outlets perceived the Swedish response as lenient, additional restrictions and recommendations were swiftly introduced during the following days, including reduced attendance at public gatherings, social distancing measures, and distancing requirements for restaurants. Furthermore, in March 2020, it was announced that high schools, colleges, and universities would shut down for on-site

⁷Public Health Agency of Sweden, press release from February 13, 2020, "No spread of the new coronavirus in Sweden," <https://www.folkhalsomyndigheten.se/nyheter-och-press/nyhetsarkiv/2020/februari/ingen-spridning-av-coronavirus-i-sverige/>, last retrieved October 29, 2021.

⁸Public Health Agency of Sweden, press release from March 11, 2020, "Recommended restrictions: No public gatherings with more than 500 persons," <https://www.folkhalsomyndigheten.se/nyheter-och-press/nyhetsarkiv/2020/mars/forslag-inga-allmannasammankomster-med-fler-an-500-personer/>, last retrieved October 29, 2021.

learning and would switch to remote learning.⁹

In addition to its effects on public life, the economic impact of the COVID-19 crisis became evident by mid-March 2020. From mid-March until mid-May, around 60,000 additional workers were registered as unemployed as compared to a decrease of 9,000 workers over the same time period in the previous year (Hensvik and Skans, 2020). Workers in search of a job faced dire prospects at that time as the number of vacancies decreased notably in the first and second quarter of 2020, as shown in Table A.2 in the Appendix. Among the sectors that were particularly hard hit, the service sector stands out. By the end of the first quarter of 2020, vacancies in the hotel and restaurant sector had already decreased by 86% as compared to the first quarter in 2019. Other particularly hard-hit sectors were transport and warehouse (decrease of 46% and 83% in vacancies in the first and second quarter of 2020, respectively, as compared to the same quarter in 2019) and services in the cultural sector (decrease of 30% and 74% in vacancies in the first and second quarter of 2020, respectively, as compared to the same quarter in 2019). Across all sectors, vacancies decreased by 15% in the first quarter of 2020 and 53% in the second quarter as compared to the corresponding quarter in the previous year.

3 Data and empirical framework

The aim of this paper is to analyze whether high school applicants in Sweden altered their program choices in response to the COVID-19 pandemic. The popularity of certain programs would likely vary across cohorts even in the absence of the pandemic; thus, simply comparing the level of applications in a post-pandemic year to the level of applications in a pre-pandemic year might be misleading. Instead, our empirical approach exploits a feature of the application process that allows students to submit preliminary preference rankings for different programs by mid-February and to alter their choices by mid-May. In 2020, the timeline of this two-step process happened to provide pre- and post-crisis snapshots of applicants' program choices. Thus, we can capture the im-

⁹Public Health Agency of Sweden, press release from March 17, 2020, "Switch to distance learning at universities and high schools,"

<https://www.folkhalsomyndigheten.se/nyheter-och-press/nyhetsarkiv/2020/mars/larosaten-och-gymnasieskolor-uppmanas-nu-att-bedriva-distansundervisning/>, last retrieved October 29, 2021.

mediate effect of the pandemic by estimating how the change in demand between the rounds in 2020 differs from the change in demand between the rounds in 2019. The advantage of this difference-in-differences approach is that we control for other factors in society that could affect applicants' preference ranking of high school programs but which are not associated with the pandemic.

An important practical issue is that our identification strategy requires data from both the preliminary and final admission rounds each year. However, the National Agency for Education only collects data on final-round applications. To overcome this issue, we contacted all high school admission centers in Sweden and requested information on preliminary and final round applications for the year 2020, as well as several years prior to the pandemic. Although the admission centers could not provide individual-level data, the majority were able to provide school-level information on the number of applications to each specific program for both admission rounds. Our ensuing data set includes around 3,000 school and program combinations each year, covering more than 80% of schools and almost 90% of applicants nationwide (see Figure 2). We have remarkable geographical coverage, with data from both rural and urban areas, including the three biggest cities in Sweden (Stockholm, Gothenburg, and Malmö) as well as remote areas in northern Sweden.¹⁰

Importantly, even though we do not have individual-level data, we observe the number of applicants who list a specific combination of school and program as the top choice on their application in each admission round. We use this information to measure what we call the *change in demand for a program*. For ease of exposition, we aggregate together several closely related programs,¹¹ and calculate the following outcome for each pooled program p :

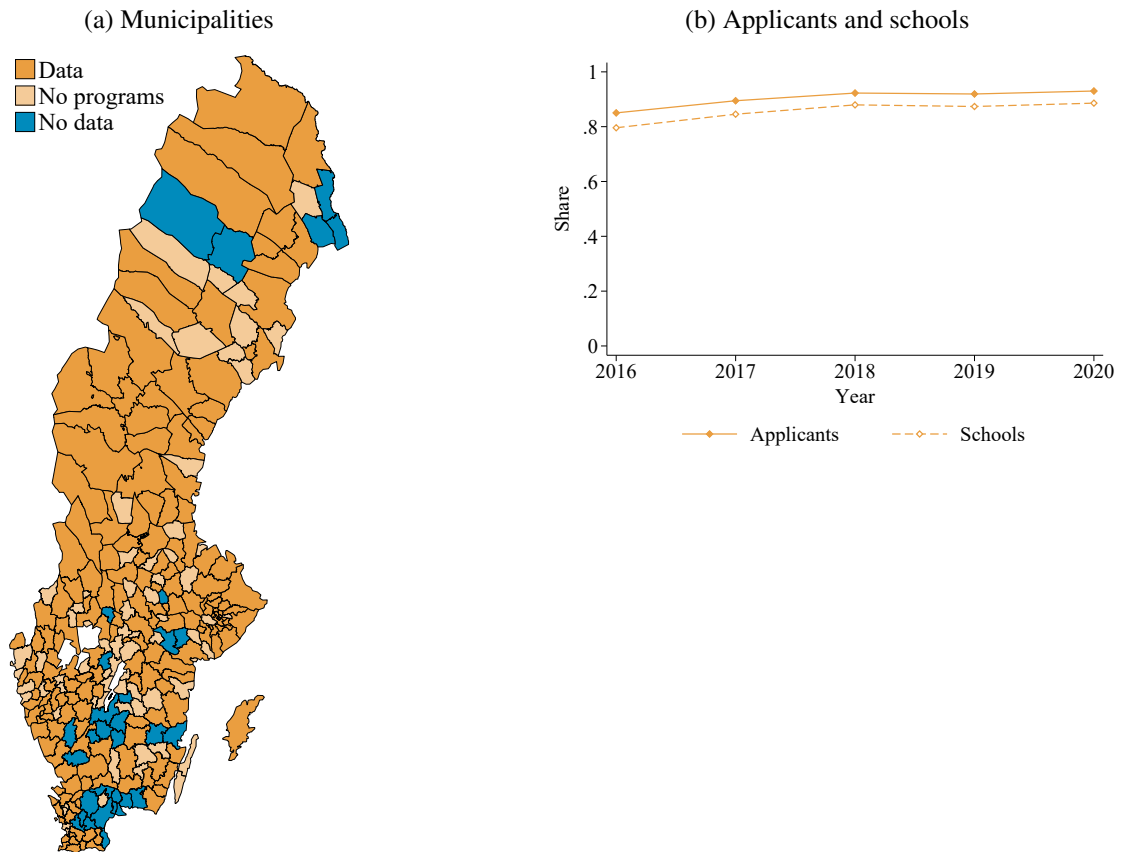
$$\Delta Demand_{psy} = FinalApplications_{psy} - PreliminaryApplications_{psy} \quad (1)$$

where $FinalApplications_{psy}$ denotes the number of applicants who list program p at school s as the top choice on their application in the final round in admission year y , and

¹⁰We document the data coverage in more detail in the Appendix. Figure A.1 plots the number of schools and school and program combinations each year, while Table A.3 provides descriptive statistics on the number of schools, municipalities, and applicants as well as the coverage of applicants separately by program in the year prior to the pandemic.

¹¹We pool programs that are closely related in terms of curriculum and/or occupational trajectory. See Table A.1 and the discussion in Section 4.1 for more detail.

Figure 2: Coverage of collected data.



Notes: In the map in panel (a), all municipalities that are fully or partially covered by our data are shaded in dark orange. Municipalities without high school programs are shaded in light orange. Municipalities for which we were unable to obtain data are shaded in blue. In panel (b), the solid (dashed) line plots the share of final-round applicants (schools) that we cover nationwide for each year in our sample.

$PreliminaryApplications_{psy}$ denotes the same number for the preliminary round. The outcome $\Delta Demand_{psy}$ thus measures how the demand for program p changed between the preliminary and final round, with positive values indicating increased demand.

In order to study the effect of the pandemic on program demand, we regress $\Delta Demand_{psy}$ – separately by program – on a set of time dummies (δ_y), school fixed effects (γ_s), and time-varying school characteristics (X_{sy}) that might affect the desirability of different schools. More specifically, our regression model has the following form, with the error term denoted by ϵ_{psy} and standard errors clustered at the school level for inference:

$$\Delta Demand_{psy} = \alpha + \sum_{y=2016}^{2018} \delta_y + \delta_{2020} + \gamma_s + \beta X_{sy} + \epsilon_{psy}, \quad (2)$$

Our parameter of interest, δ_{2020} , measures the difference in demand for program p between the two rounds in 2020 as compared to the difference in demand between the two application rounds in the baseline year 2019. It captures the immediate causal impact of the pandemic, under the standard difference-in-differences assumption that the difference in the number of applications between the final and preliminary round had been the same as in previous years in the absence of the pandemic. The inclusion of $\sum_{y=2016}^{2018} \delta_y$ allows us to estimate the same difference in previous years in the absence of the pandemic and test the plausibility of this assumption. If the estimates for these years differ from zero, the estimate for year 2020 is less reliable. We report the results of this exercise in Section [4.3](#) after discussing the main results.

3.1 Control variables

In order to increase the plausibility of the parallel trends assumption, we include school fixed effects (γ_s) to control for local time-constant differences that might affect program demand between the rounds. We also include a vector of time-varying school-level characteristics of students and staff (X_{sy}) in order to account for the fact that changes at the school level could explain part of the variation in the change of the popularity of programs. To that end, we combine our self-collected data with information from the Swedish National Agency for Education on school-level characteristics that might affect the desirability of a school. These characteristics are measured in the fall term

immediately prior to application.¹²

The characteristics of the student body at school s include the share of female students, the share of students with a foreign background, and the share of students with highly-educated parents. The Swedish National Agency for Education defines the share with foreign background as the share of students who are either born outside of Sweden or as students whose parents both were born outside of Sweden. Students without a national identity number are counted as foreign.¹³ Students are counted as having highly-educated parents if their parents have obtained at least the equivalent of one full-time semester of studies (equivalent to 30 higher education credits) at the tertiary education level. In addition, we control for the grade point average of the most recent graduating class from school s (i.e., the previous spring term).

The characteristics of the staff at school s include the share of certified teachers and the student-teacher ratio. The share of certified teachers is measured as the share of teachers who have a university degree in pedagogy out of all teachers with full-time positions. The student-teacher ratio is measured as the number of students enrolled in October per full-time equivalent teacher.

3.2 Mechanisms for program changes between rounds

We want to capture how program demand changed between the preliminary and final rounds due to the arrival of the pandemic. To that end, our outcome variable $\Delta Demand_{psy}$ measures the change in top-ranked applications to each program between the two rounds. If it were mandatory to apply in the preliminary round, then these changes should sum to zero across all programs and schools. However, a small share of applicants — around 4–5% — do not submit an application until the final round. Thus, $\Delta Demand_{psy}$ captures several different sources of variation:

- (i) switches out of a program: applicants who initially ranked program p at school s

¹²The student and staff characteristics are collected only once per year in mid-October. The application process occurs several months after this, but it would be unusual for there to be significant changes between the fall and spring term of the same school year, so the characteristics from October should accurately capture the characteristics at the time of application.

¹³In practice, all children born to Swedish residents are assigned a national identity number at birth. Children of non-residents obtain a national identity number once they are registered as residents which requires a residence permit or right of residence within the European Union.

as their top choice in the preliminary round but changed their top-ranked choice in the final round or withdrew their application entirely,

- (ii) switches into a program: applicants who ranked a different program and/or school as their top choice in the preliminary round but ranked program p at school s as their top choice in the final round,
- (iii) applicants who did not submit any application in the preliminary round but decided they wanted to attend program p at school s in the final round.

It is possible that the pandemic affected each of these channels. Below, we outline the possible drivers behind these changes.

The most obvious mechanism is that students who applied during the preliminary admission round shifted their program preferences in response to the COVID-19 outbreak. A likely explanation with support in the literature is that students adjusted their expectations about the labor market prospects of certain fields of study in response to the economic fallout due to the pandemic. However, we cannot exclude the possibility that changes in applications could have been influenced by (true or perceived) supply-side considerations. While there is no evidence that schools changed the programs on offer between the preliminary and final rounds,¹⁴ there was a lot of uncertainty about how the pandemic would affect firms' ability to organize the practical training that is included in all vocational programs. For instance, there was uncertainty whether training in facilities such as retirement homes could take place during the pandemic. Students who anticipated such supply-side disruptions might have consequently chosen to opt out of programs with a higher likelihood of disruptions in the practical training. We conduct several robustness checks to try to rule out this supply-side channel in Section 5.2.

It is important to point out that the pandemic might not only have influenced the program choices of new high school applicants, but also of students who were already enrolled in a high school program. For example, students in programs that were hit hard by the pandemic might have wanted to switch to programs with better labor market prospects. Unfortunately, our self-collected data does not allow us to differentiate between applicants who were applying directly from ninth grade and applicants who were

¹⁴See the discussion on how the COVID-19 outbreak affected the number of available places per program in Section 5.2

applying from high school. However, official aggregate statistics at the national level indicate that the share of students who apply directly from ninth grade was very stable over our study period, particularly between years 2019 and 2020 (see Figure [A.2](#)).

A final possibility is that the pandemic may have influenced students' decisions to attend high school. Since it is not mandatory to apply in the preliminary round, even if this is the standard and recommended practice, there are students who only apply in the final round and who thus do not contribute to preliminary round statistics. Our data reflects this fact, showing that the number of applications is always slightly higher in the final round as compared to the preliminary round. Another potential change in the number of final-round-only applications to a certain program could therefore reflect that students who did not submit a preliminary application were deterred from applying at all (if there was evidence of a decline in applications) or that students who would not have applied at all were induced to apply (if there was an increase in applications). Note that this potential explanation behind a change in number of applications is not in conflict with our identification strategy as long as the trends in preliminary and final round applications would not have been different in the absence of the pandemic.

4 Results

This section presents evidence on how the early stages of the COVID-19 pandemic affected students' demand for different high school programs. In Section [4.1](#), we start by analyzing some descriptive trends in the number of preliminary- and final-round applicants over our study period. Next, Section [4.2](#) discusses our formal difference-in-differences estimates of the immediate effect of the pandemic on program demand. Finally, we evaluate the parallel trends assumption underlying our main model in Section [4.3](#) using a difference-in-differences event-study setup.

4.1 Descriptive trends in demand for programs over time

Table [A.4](#) in the Appendix displays the number of applicants in our sample data separately for the preliminary and final admission round. In 2020, we record 110,421 applicants in the preliminary admission round and 114,589 applicants in the final round in our data, of which 34% and 36% respectively applied to vocational programs. Between

2016 and 2020, the number of total applicants in both rounds increased by about 25%, in part due to better data coverage during later years but also due to an increase in cohort size accounting for about half the increase in applicants. Prior to 2020, applications increased by around 5% between preliminary and final admission rounds, while the corresponding increase in our sample was less than 4% in 2020. The increase between the preliminary and final round reflects that it is not mandatory to submit an application in the preliminary round, although this is the standard and recommended practice.

In general, academic programs have notably more applicants than the vocational programs. Roughly one third of all applicants applied to vocational programs in the preliminary round, while the other two thirds applied to academic programs. The corresponding share of applicants to vocational programs is slightly higher in the final round, but close to the actual share of students who enroll in vocational programs.

Figure 3 shows the program-specific trends in total number of applicants between 2016 and 2020. In order to improve precision and for ease of exposition, we pool together several programs that are closely related in terms of educational curriculum and/or occupational trajectory.¹⁵ Panel A shows the trends for vocational high school programs. Hotel & Restaurant (3a) shows the pooled trends for the Hotel & Tourism program and the Restaurant & Food program, which are all related to the hospitality industry and were part of the same program prior to 2011. Building & Industry (3h) consists of Building & Construction, Electricity & Energy, Industrial Technology, and HVAC & Property Maintenance. The Building & Industry programs all have very technical content and are broadly related to the production of goods and energy.

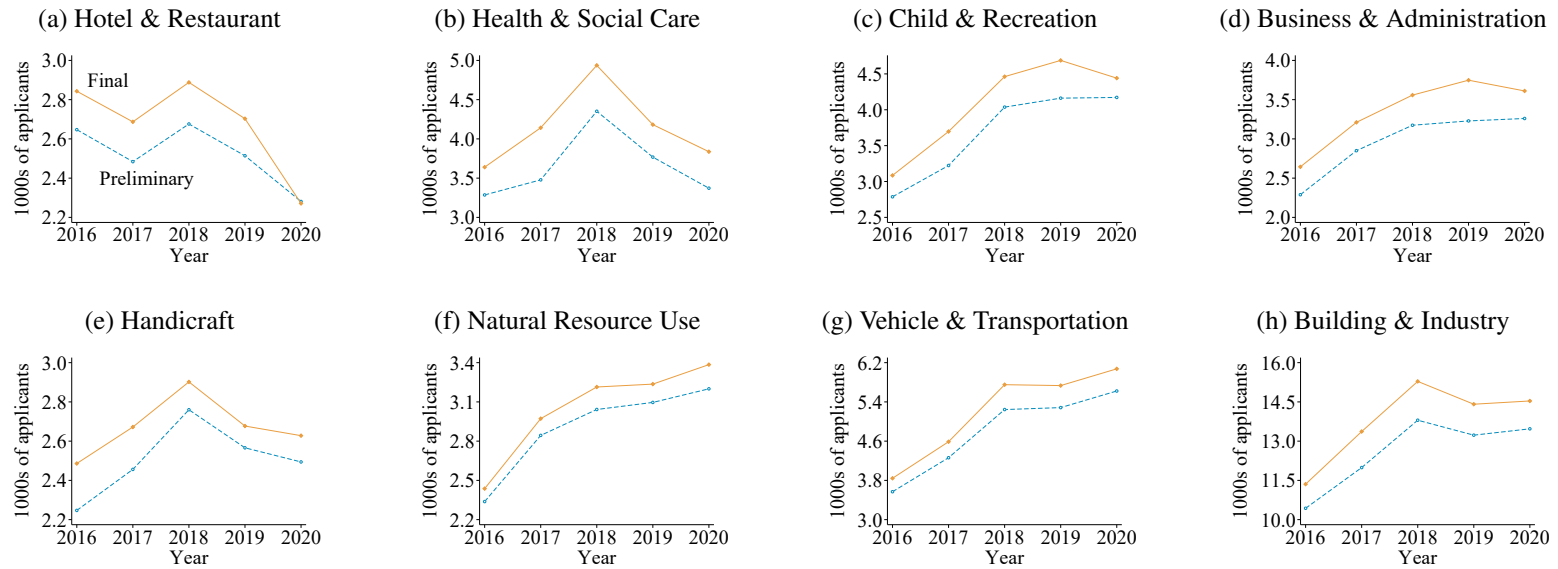
There are some general observations to make. First of all, there is a lot of variation in how popular the different vocational programs are as measured by the number of applicants (Figure 3). Second, the trends are upward-sloping in the earlier years due to increasing cohort sizes and the fact that we have better coverage of applicants in the later years. Importantly, however, we have both preliminary and final round data for each program within a school for all years. Hence, we can conclude that the trends in applicants in both rounds seem to follow each other very closely until 2019.

The trends in Figure 3 are also indicative of a change in patterns in 2020, suggesting that the decrease in the total number of additional applicants between the preliminary

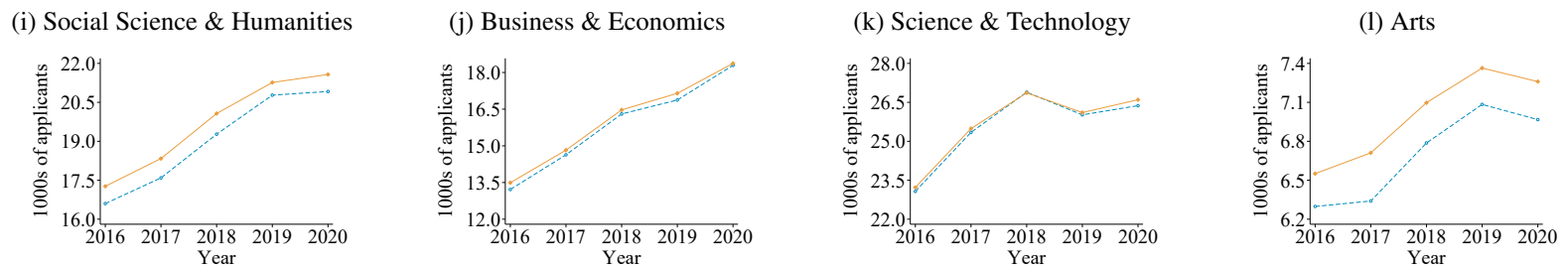
¹⁵Note that our results are not sensitive to alternative methods of pooling the data (results available upon request) or running the regressions separately by program (see Table A.3 in the Appendix).

Figure 3: Trends in number of first-choice applicants by program in preliminary and final rounds.

Panel A: Vocational programs



Panel B: Academic programs



Notes: The solid orange (dashed blue) line plots the number of applicants who rank a given program as their top choice in the final (preliminary) round.

and final round might be attributable to changes in a few specific programs. Within service-oriented programs, most notably the Hotel & Restaurant program and the Child & Recreation program, first-choice applications appear to have increased less between the preliminary and final round as compared to previous years.

Note also the spike in applications in both rounds in 2018 for the Health & Social Care program. There is evidence that final-round applications had already increased in the final round in 2017 relative to the preliminary round. The patterns coincide with an increase in the number of male applicants and an increase in applicants who did not fulfill basic entry requirements to this program. This particularity is most likely due to changes in the regulations for obtaining a residence permit for minors arriving in Sweden in 2017 and 2018. Under the new regulations, minors who arrived prior to the end of 2015 and whose asylum application had previously been declined could be granted temporary asylum if they were enrolled in high school and fulfilled certain other requirements. The first of those laws was passed in May 2017, shortly before final applications had to be submitted in that year. It is likely that the increase in applicants in 2017 and 2018 can be (partly) explained by the large number of young and mainly male refugees who tried to gain asylum. Official statistics from the Swedish National Agency for Education on applicants nationwide show that the increase in applicants to this program coincides with a decrease in (mainly male) applicants who met admission requirements.¹⁶

4.2 Estimated effect of the pandemic on program demand

The trends in the number of applicants per program in Figure 3 indicated that the arrival of the pandemic to Sweden in spring 2020 might have altered the demand for different high school programs. Formally, we analyze the impact of the pandemic on field-of-study choices by estimating the difference-in-differences specification in Equation 2. In Figure 4, we display the estimate of interest, δ_{2020} , and corresponding 95% confidence intervals for each program.¹⁷ As described in Section 4.1, we pool programs that are

¹⁶The share of applicants that met admission requirements for Health & Social Care decreased from 66% in 2016 to 60% in 2017 and 55% in 2018. The decrease in applicants who met entry requirements was most pronounced among male applicants, from 60% who met requirements in 2016 to 51% in 2017 and 43% in 2018 (Swedish National Agency for Education, [online statistics](#).)

¹⁷The corresponding point estimates are also displayed in Table 1, Column 4.

closely related in terms of curriculum and/or occupational trajectory.¹⁸ Each program-specific estimate shows the effect of the COVID-19 pandemic in 2020 on the demand for the indicated program.

The results imply that the pandemic mainly had a negative effect on the demand for some of the vocational programs. We find significant negative effects in three programs: Hotel & Restaurant, Child & Recreation, and Business & Administration. In order to interpret the size of the effects, we compare the effect size to the mean number of applicants in the analysis year prior to the pandemic (2019). The estimated effect of the pandemic on applications to the Hotel & Restaurant program corresponds to a decrease of 1.5 in the average number of applications per school and program, explaining 8% of the variation in the average number of applications to the Hotel & Restaurant program and is thus of economic importance.¹⁹ In the Child & Recreation program, top-ranked applications decreased by 1.7 applications (roughly 6%) per school and program, as compared to the previous year. In addition, the COVID-19 pandemic led to a decrease of 1.1 (roughly 5%) in the average number of top-ranked applications to the Business & Administration program.

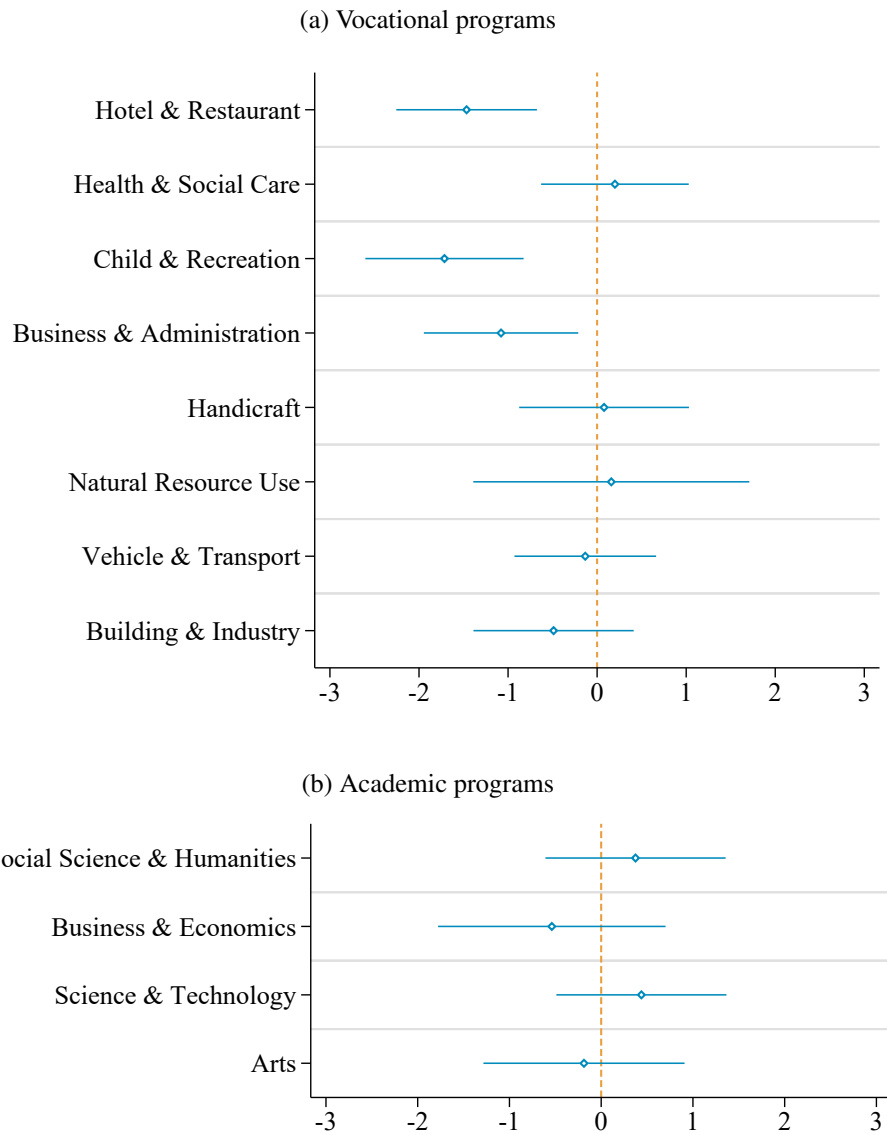
Interestingly, we do not observe that the decrease in top-ranked applications to the above-named vocational programs is mirrored by an increase in applications to other vocational programs. One possibility is that the students who opted out of the above-named vocational programs chose to enroll in academic programs instead. If students believe that the crisis will have a persistent negative effect on the labor market, more students might opt for academic preparatory programs rather than vocational programs, as higher education is often perceived to offer better career prospects during a depressed labor market and allows students to postpone labor market entry during bad times. However, the results for the academic programs in Figure 4b show that the declines in applicants are not compensated by systematic shifts towards any of the academic programs: none of the estimated effects for these programs are significantly different from zero.

Thus, the fact that program-specific declines in applicants are not compensated by increases in other programs suggests either that shifts towards other programs are not

¹⁸For completeness, Figure A.3 in the Appendix displays the results for each of the 18 national programs individually. The main findings are unchanged in these unpooled estimations.

¹⁹A closer look at the non-pooled results in Figure A.3 in the Appendix shows applications to both the Hotel & Tourism and the Restaurant Management & Food program declined, though the estimate for Restaurant Management & Food is smaller in size and only significant at the 10% level (P-value 0.077).

Figure 4: Estimated effect per program, first-choice applicants.



Notes: The regression specification controls for school fixed effects and time-varying school-level controls. The horizontal lines show 95% confidence intervals, with standard errors clustered at the school level.

systematic and therefore too small to be picked up by our method, or that the decline in applications between the preliminary and final round is (at least partly) driven by undecided students who did not submit a preliminary application.

While the results show that the pandemic had sizable effects on the number of applicants to programs that were vulnerable to the pandemic in some dimension, the vast majority of students did not alter their choices.

4.3 Assessing the parallel trend assumptions

Our main difference-in-differences model relies on the assumption that the change in top-ranked applications between the preliminary and final round would have evolved similarly in the absence of the pandemic. In order to assess the plausibility of this parallel trends assumption, we analyze the impact of the pandemic on study choices in the years prior to the pandemic. We obtain a parameter estimate of the difference in applicants between the preliminary and final round for each sample year (2016–2018 and 2020) relative to our base year (2019). For ease of exposition, we only display the parameter estimate for 2020 in Section 4.2, which captures the effect of the COVID-19 pandemic on the demand for a specific program. In Figure A.4 in the Appendix, we display event study plots of the full set of the δ -estimates, which measure the difference in applicants between the rounds for each sample year relative to base year 2019. If the parallel trends assumption holds, we would expect the estimates prior to 2019 to be close to zero.

In support of our main results, we see no evidence of diverging trends in the difference of top-ranked applications between the two rounds for the Hotel & Restaurant and Child & Recreation programs, and the estimate is very close to zero in all years prior to 2019. There is also no evidence of pre-trends for the Business & Administration program, even though estimates for 2016–2018 are slightly negative but not statistically distinguishable from zero. However, for several of the other vocational programs (e.g., Health & Social Care and Building & Industry), some of the pre-pandemic estimates are statistically different from the base year estimate. For years 2017 and 2018, one possible explanation is the increase in the number of applications by young male refugees (see discussion in Section 4.1) who were mainly directed towards the Health & Social Care program.

5 Robustness

5.1 Model specifications

In our main specification in Equation 2 we include school fixed effects and time-varying school characteristics in order to control for differences in the desirability between schools. In practice, it is reassuring that the inclusion of these characteristics has little impact on our estimates, suggesting there is little to indicate that changes in the desirability of schools over time account for switching behavior. Table 1 shows how our estimate of interest changes as we start out with a difference-in-differences baseline specification without any controls or fixed effects (Column 1) and step-wise introduce additional covariates (Columns 2–3) until we arrive at our preferred specification in Equation 2 (Column 4).

Instead of exploiting variation within the same school (and program) over rounds and time, the identifying variation in the uncontrolled specification (Column 1) stems from differences between rounds and programs across schools in this less restrictive estimation. Reassuringly, the results for both the vocational and the academic programs are very similar to the ones obtained in our main specification. In Column 2, we see that the introduction of school-level controls has little effect on our results. For the three programs that we found were affected by the pandemic, the inclusion of the controls only leads to a slight increase in magnitude of the results, suggesting that changes in the desirability of schools are of only little concern for our estimation strategy. In Column 3, we instead include school fixed effects, such that the identifying variation stems from changes within schools over time, which increases the size of our estimates further. However, the estimates for Hotel & Restaurant, Child & Recreation, and Business & Administration are rather stable throughout all specifications.

5.2 Supply-side distortions

A potential concern for our interpretation of the results would arise if a decline in applicants would reflect supply-side changes (due to the pandemic) rather than changes in the demand for programs. For instance, students might have altered their program choices due to concerns about whether the on-the-job training could take place during the pandemic. The COVID-19 outbreak likely put limits on the provision of on-the-job

Table 1: Robustness checks for the main results.

	Specification checks				
	No controls or FEs (1)	Only school controls (2)	Only school FEs (3)	School FEs + controls (4)	Excluding apprentices (5)
Panel A: Vocational programs					
Hotel & Restaurant <i>[Avg = 1.332; Obs₁₋₄ = 695; Obs₅ = 590]</i>	-1.383*** (0.409)	-1.403*** (0.413)	-1.466*** (0.405)	-1.465*** (0.400)	-1.323*** (0.454)
Health & Social Care <i>[Avg = 2.361; Obs₁₋₄ = 878; Obs₅ = 711]</i>	0.333 (0.411)	0.212 (0.426)	0.221 (0.415)	0.200 (0.420)	0.279 (0.473)
Child & Recreation <i>[Avg = 3.086; Obs₁₋₄ = 801; Obs₅ = 675]</i>	-1.512*** (0.431)	-1.561*** (0.450)	-1.656*** (0.436)	-1.714*** (0.450)	-1.971*** (0.508)
Business & Administration <i>[Avg = 3.105; Obs₁₋₄ = 854; Obs₅ = 684]</i>	-0.949** (0.435)	-1.067** (0.438)	-1.098** (0.441)	-1.079** (0.440)	-1.191** (0.537)
Handicraft <i>[Avg = 0.884; Obs₁₋₄ = 651; Obs₅ = 518]</i>	0.205 (0.466)	0.224 (0.476)	0.117 (0.475)	0.078 (0.482)	0.167 (0.582)
Natural Resource Use <i>[Avg = 1.632; Obs₁₋₄ = 435; Obs₅ = 389]</i>	0.638 (0.871)	0.410 (0.856)	0.343 (0.860)	0.159 (0.782)	0.113 (0.847)
Vehicle & Transport <i>[Avg = 2.763; Obs₁₋₄ = 867; Obs₅ = 681]</i>	0.017 (0.397)	0.067 (0.403)	-0.099 (0.401)	-0.133 (0.403)	-0.090 (0.493)
Building & Industry <i>[Avg = 3.737; Obs₁₋₄ = 1,517; Obs₅ = 1,384]</i>	-0.358 (0.473)	-0.300 (0.471)	-0.490 (0.456)	-0.489 (0.457)	-0.455 (0.487)
Panel B: Academic programs					
Social Science & Humanities <i>[Avg = 1.254; Obs₁₋₄ = 1,934; Obs₅ = N/A]</i>	0.353 (0.486)	0.281 (0.486)	0.362 (0.494)	0.374 (0.500)	N/A
Business & Economics <i>[Avg = 0.886; Obs₁₋₄ = 1,499; Obs₅ = N/A]</i>	-0.645 (0.609)	-0.621 (0.613)	-0.651 (0.627)	-0.538 (0.630)	N/A
Science & Technology <i>[Avg = 0.216; Obs₁₋₄ = 1,955; Obs₅ = N/A]</i>	0.311 (0.454)	0.318 (0.456)	0.355 (0.465)	0.438 (0.472)	N/A
Arts <i>[Avg = 1.451; Obs₁₋₄ = 971; Obs₅ = N/A]</i>	0.008 (0.539)	-0.063 (0.602)	-0.156 (0.549)	-0.187 (0.556)	N/A

Notes: Each row reports the estimate of δ_{2020} for a particular program and model specification. In the column title, FE stands for fixed effects. The results from the main model (Equation 2) are shown in Column 4. In square brackets, we list the average outcome in the baseline year 2019, as well as the number of observations for each regression (Obs_{1-4} for Columns 1–4 and Obs_5 for Column 5). Standard errors are clustered at the school level and shown in parentheses. Significance levels are denoted with stars: *** for $p < 0.01$; ** for $p < 0.05$; and * for $p < 0.10$.

training due to both economic and health concerns connected to taking on new personnel. This was likely a bigger concern in programs that require close contact between individuals, such as Child & Recreation, where on-the-job training includes close contact with children and social distancing is difficult. Such considerations should be even more relevant for so-called apprenticeship programs that are organized in close collaboration with employers and where a much larger share of the education (around 50%) consists of on-the-job training. About 12% of the programs in our data are apprenticeship programs.

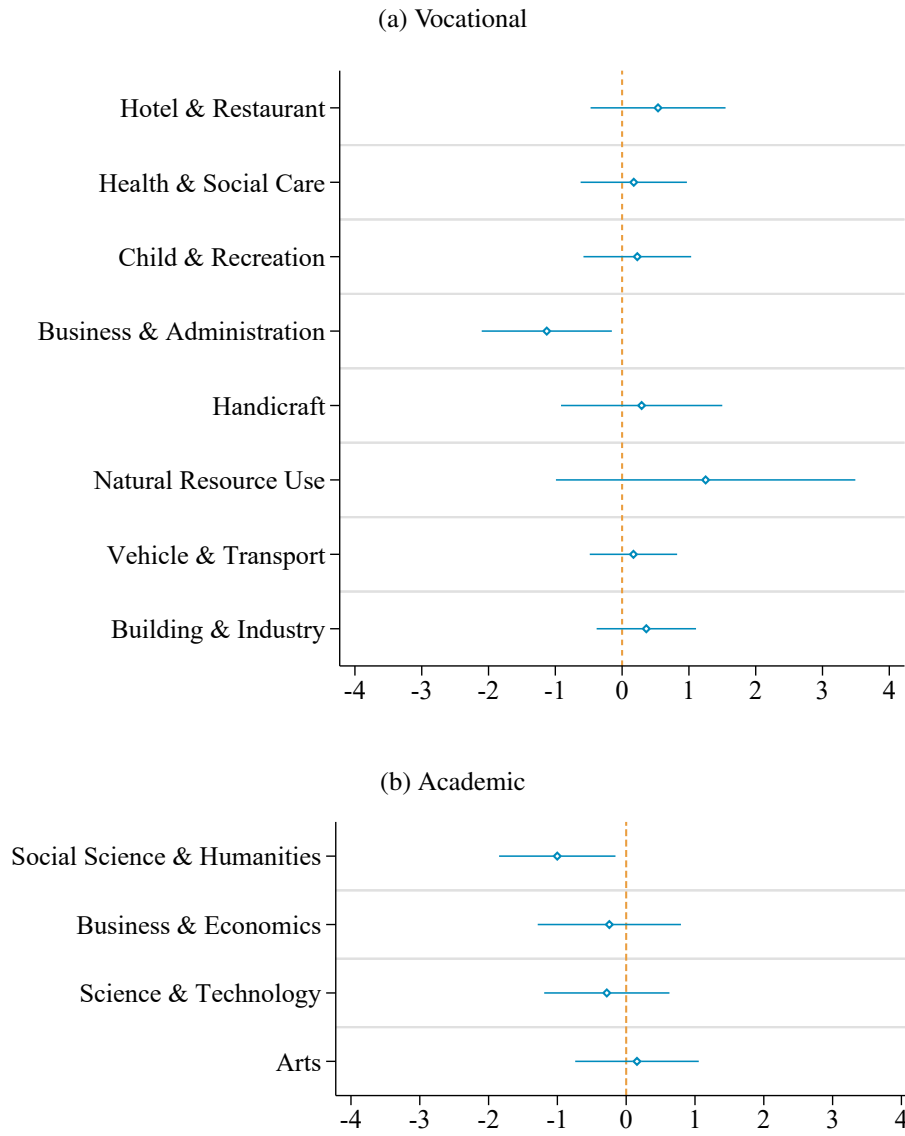
In order to test whether our results could be driven by real or perceived limitations in available apprenticeship slots, we re-estimate our main results for all vocational programs after excluding apprenticeship programs.²⁰ The results without these programs are shown in Column 5 of Table 1. The effects are very similar to our main results and confirm the existence of a negative effect on the popularity of the programs Hotel & Restaurant, Child & Recreation, and Business & Administration. Thus, these results do not appear to be driven by supply-side considerations with regard to the feasibility of apprenticeship programs during the pandemic.

Supply-side distortions could also arise if (perceived) changes in demand for certain programs led to expansions or contractions in the number of offered places. In the case of the pandemic, it is possible that schools reacted to anticipated changes in demand and/or tried to steer students towards or away from certain programs by adjusting the number of available places. While such supply-side adjustments would be a bigger concern if we were looking at enrollment instead of applications, it is still possible that knowledge about changes in the availability of places had an effect on students' application decisions. Thus, a likely scenario that would affect the interpretation of our results would occur if students changed their program choices as they, rightly or wrongly, believed that adjustments in the number of available places affected the likelihood of being admitted to certain programs.

We can address this concern by estimating how the COVID-19 pandemic affected the number of available places within a program in our difference-in-differences setup. To be precise, we estimate Equation 2 using the difference in the number of available places per program, $\Delta Places_{psy}$, as the outcome. The results are displayed in Figure 5.

²⁰Since apprenticeship programs account for only 12% of all programs, we do not have enough precision to investigate the effect on apprenticeship programs separately.

Figure 5: Estimated effect on the number of available places per program.



Notes: Each point plots the estimate of δ_{2020} from a modified version of Equation 2 — run separately by program — in which the dependent variable is equal to the change in the number of available places between the rounds ($\Delta Places_{psy}$). The horizontal lines show 95% confidence intervals with standard errors clustered at school level.

There is no indication that changes in the availability of places can explain the decline in top-ranked applications to the Hotel & Restaurant or Child & Recreation programs. The point estimates are not statistically significant and slightly positive, suggesting that there is no evidence of a reduction of places in these programs. The only estimates that stands out is for Business & Administration, which points to a decrease of 1.1 available places per school and program. The estimates for the other vocational programs are generally small and clearly insignificant and mainly point to a slight expansion of places, which is unlikely to have a negative impact on applications and would point towards under- rather than overestimating our main results. In the case of Business & Administration, this would suggest that the point estimate of -1.1 in our main specification can be attributed to a decrease in available places. The only academic program that appears to be affected by supply-side changes is the Social Science & Humanities program, for which we see a very slight reduction in available places of -0.9, corresponding to a decrease of less than 2% in relation to the mean number of places. Given the small and insignificant point estimate on the change in number of applications in Figure 4b, the slight reduction in available places is unlikely to be of economic importance.

6 Conclusions

In this paper, we use a difference-in-differences strategy to show that the COVID-19 pandemic led to a decrease in high school applicants' demand for several vocational programs, while academic programs were unaffected. We find the largest decline in top-ranked applications to the Hotel & Restaurant program, which is incidentally the sector in which employment was affected the most during the pandemic. The negative effect is consistent with the interpretation that students respond to sector-specific changes in labor market prospects when choosing their field of study. There is also robust evidence of a decline in top-ranked applications to the Child & Recreation program. While the reduced demand for the Child & Recreation program is also in line with reduced labor demand in related sectors, it is possible that factors other than labor market considerations might have contributed to the decline in applicants — for example, increased risk of infection due to close contact with children.

The fact that we find any change in demand for programs is remarkable considering

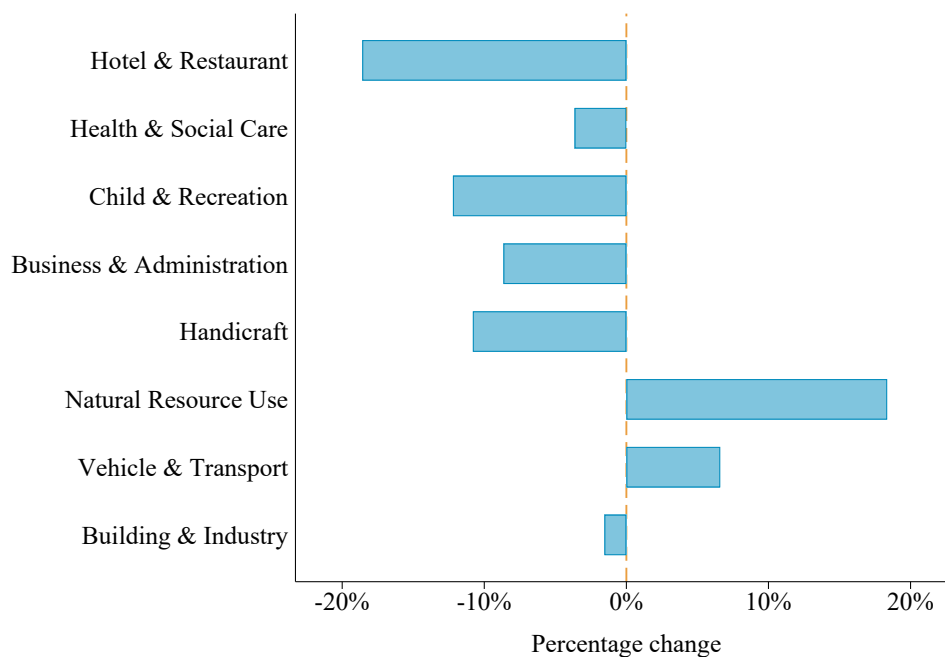
that we only capture the effect of the early stages of the pandemic. While the majority of high school programs were unaffected, applicants to programs with worsening labor market prospects reacted quickly at a time when there was little certainty about the long-term impacts of the pandemic.

An open question is whether these immediate shifts in program choices will last or whether students might switch back to hard-hit industries after the COVID-19 crisis is over. For such programs as Hotel & Restaurant, which had seen a declining trend in applicants even prior to the pandemic, it remains to be seen whether the pandemic might have sped up the decline in attractiveness of certain occupations.

Our identification strategy makes use of Sweden's two-round high school admission process, which happened to provide pre- and post-pandemic snapshots of applicants' program choices in 2020. We cannot implement the same method to evaluate the effects of the pandemic on program choices in 2021 because both admission rounds occurred post-pandemic. However, we can provide descriptive evidence on how final-round applications to the different programs changed in 2021 as compared to our base year 2019. In line with our findings, Figure 6 shows that the decline in top-ranked applications between 2019 and 2021 is largest for the Hotel & Restaurant and Child & Recreation programs. Demand for these programs, as well as for several other service-oriented programs, remains well below pre-pandemic levels.

Future research could pin down whether changes in demand for programs due to the pandemic will lead to frictions in the labor market. Since decisions at the high school level affect the future supply of workers with a lag, the potential labor market frictions will depend on whether students' current responses to the pandemic accurately reflect future labor demand.

Figure 6: Percentage change in demand for programs in the final admission round, 2019 to 2021.



Notes: The blue bars show the percentage change from 2019 to 2021 in the number of final-round applicants who rank each program as the top choice on their application. The data comes from Statistics Sweden's official nationwide statistics and was obtained via the National Agency for Education.

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Appendix

A Tables

Table A.1: National high school programs in Sweden.

Vocational programs	Academic programs
Hotel & Tourism [†]	Social Science [¶]
Restaurant Management & Food [†]	Humanities [¶]
Health & Social Care	Business Management & Economics
Child & Recreation	Natural Science [§]
Business & Administration	Technology [§]
Handicraft	Arts
Natural Resource Use	
Vehicle & Transport	
Building & Construction [‡]	
Electricity & Energy [‡]	
HVAC & Property Maintenance [‡]	
Industrial Technology [‡]	

Notes: We denote the programs that we pool together for our main analysis with the following symbols: † for Hotel & Restaurant, ‡ for Building & Industry, ¶ for Social Science & Humanities, and § for Natural Science & Technology.

Table A.2: Vacancies per industry.

	2019		2020		%-change	
	Q1	Q2	Q1	Q2	Δ Q1	Δ Q2
Industry						
Manufacturing and mining	4,421	3,991	3,898	1,991	-12%	-50%
Energy and environment	404	540	676	488	67%	-10%
Construction	2,938	5,153	2,662	2,722	-9%	-47%
Trade	4,361	4,573	4,702	3,114	8%	-32%
Transport and warehouse	1,886	3,139	1,022	518	-46%	-83%
Hotel and restaurant	2,218	1,827	308	.	-86%	.
Information and communication	6,224	6,365	5,960	3,888	-4%	-39%
Credit, insurance, and real estate	2,304	1,354	2,146	1,314	-7%	-3%
Law, economics, science	5,104	5,589	4,300	1,960	-16%	-65%
Rental, real estate, and travel services	3,020	2,746	2,152	965	-29%	-65%
Education and care services	1,619	2,383	1,417	1,064	-12%	-55%
Personal and cultural services	523	799	367	206	-30%	-74%
Total	35,022	38,459	29,610	18,230	-15%	-53%

Notes: Data on vacancies comes from Statistics Sweden (SCB). Missing observations are due to data unavailability or uncertainty.

Table A.3: Descriptive statistics in 2019 by program.

	Schools	Municipalities	Applicants	Coverage
Vocational programs				
Hotel & Tourism [†]	82	63	1,009	0.920
Restaurant Management & Food [†]	110	89	1,694	0.913
Health & Social Care	184	135	4,182	0.877
Child & Recreation	174	126	4,688	0.907
Business & Administration	177	118	3,748	0.889
Handicraft	128	67	2,677	0.916
Natural Resource Use	91	67	3,236	0.888
Vehicle & Transport	179	132	5,733	0.892
Building & Construction [‡]	191	132	5,250	0.901
Electricity & Energy [‡]	221	135	5,893	0.908
HVAC & Property Maintenance [‡]	101	69	1,499	0.917
Industrial Technology [‡]	131	107	1,770	0.941
Academic programs				
Social Science [¶]	388	165	20,577	0.929
Humanities [¶]	39	30	688	1.000
Business & Economics	308	149	17,147	0.938
Natural Science [§]	337	162	15,686	0.930
Technology [§]	252	146	10,420	0.912
Arts	193	97	7,364	0.937
All programs	705	186	113,261	0.919

Notes: We denote the programs that we pool together for our main analysis with the following symbols: † for Hotel & Restaurant, ‡ for Building & Industry, ¶ for Social Science & Humanities, and § for Natural Science & Technology. Applicants refers to the total number of individuals who ranked the program as the top choice on their application in the final round. Coverage refers to the share of all top-ranked applications that we cover nationwide.

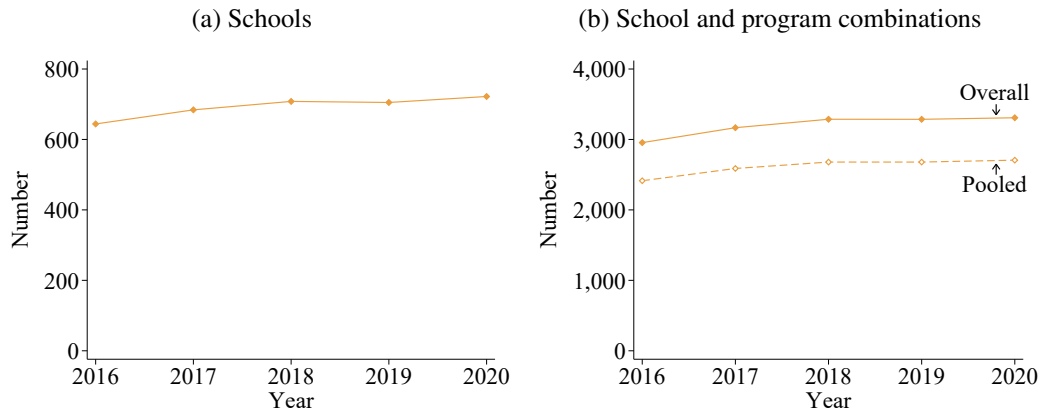
Table A.4: Descriptive statistics.

	Admission year				
	2016	2017	2018	2019	2020
Total applicants					
Preliminary round	88,782	97,495	108,341	108,602	110,421
Final round	92,868	102,696	113,498	113,261	114,589
Share vocational					
Preliminary round	0.333	0.345	0.361	0.349	0.343
Final round	0.348	0.364	0.379	0.365	0.356

Notes: This table shows the total number of applicants that we record in our self-collected data each year, as well as the share of total applicants who apply to vocational programs.

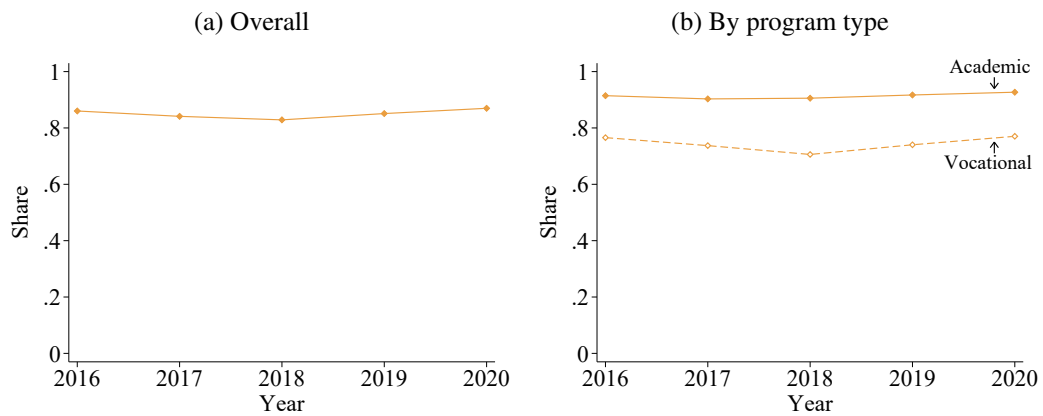
B Figures

Figure A.1: Number of schools and programs in our self-collected data.



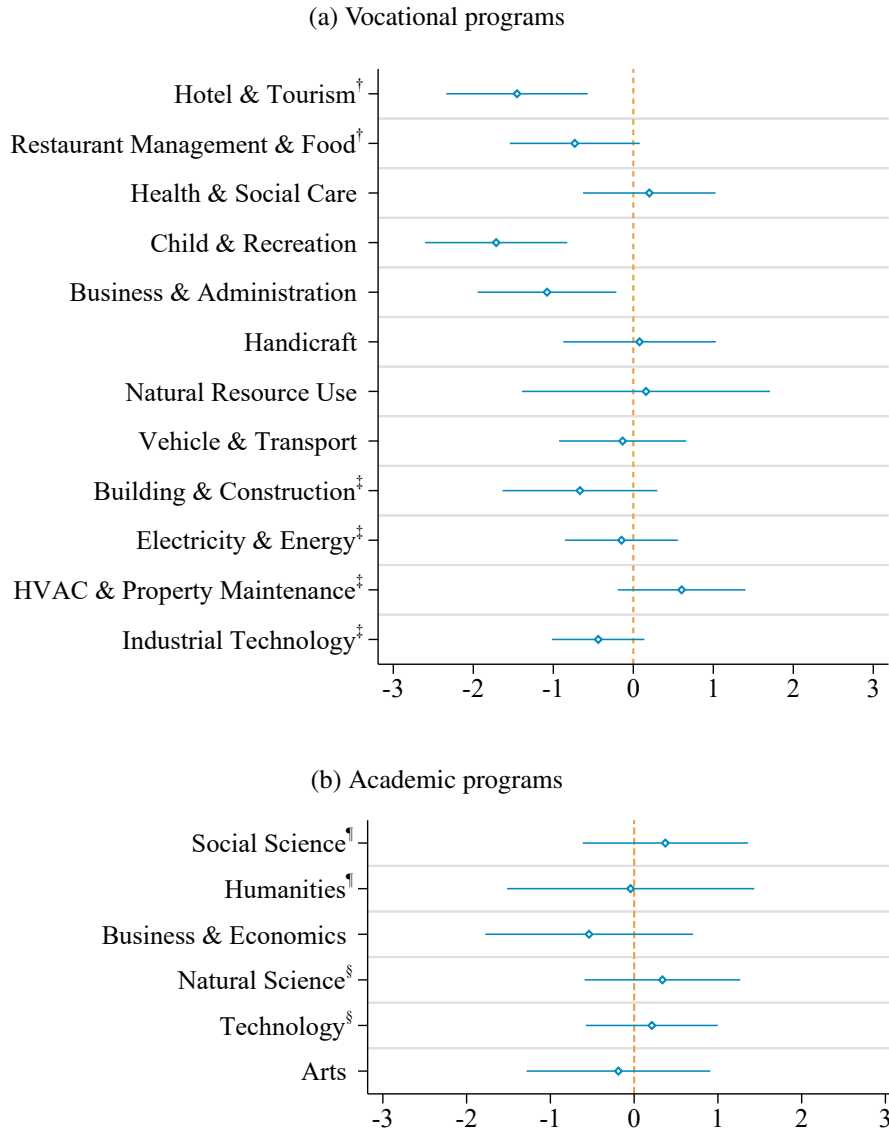
Notes: Panel (a) reports the total number of schools in our self-collected data each year, while panel (b) reports the total combinations of school and program. In panel (b), the dashed line labeled “pooled” indicates the total combinations that remain after aggregating together similar programs.

Figure A.2: Share of applicants applying directly from grade nine.



Notes: Data comes from the National Agency for Education. Shares are computed based on official final-round statistics for the entire nation.

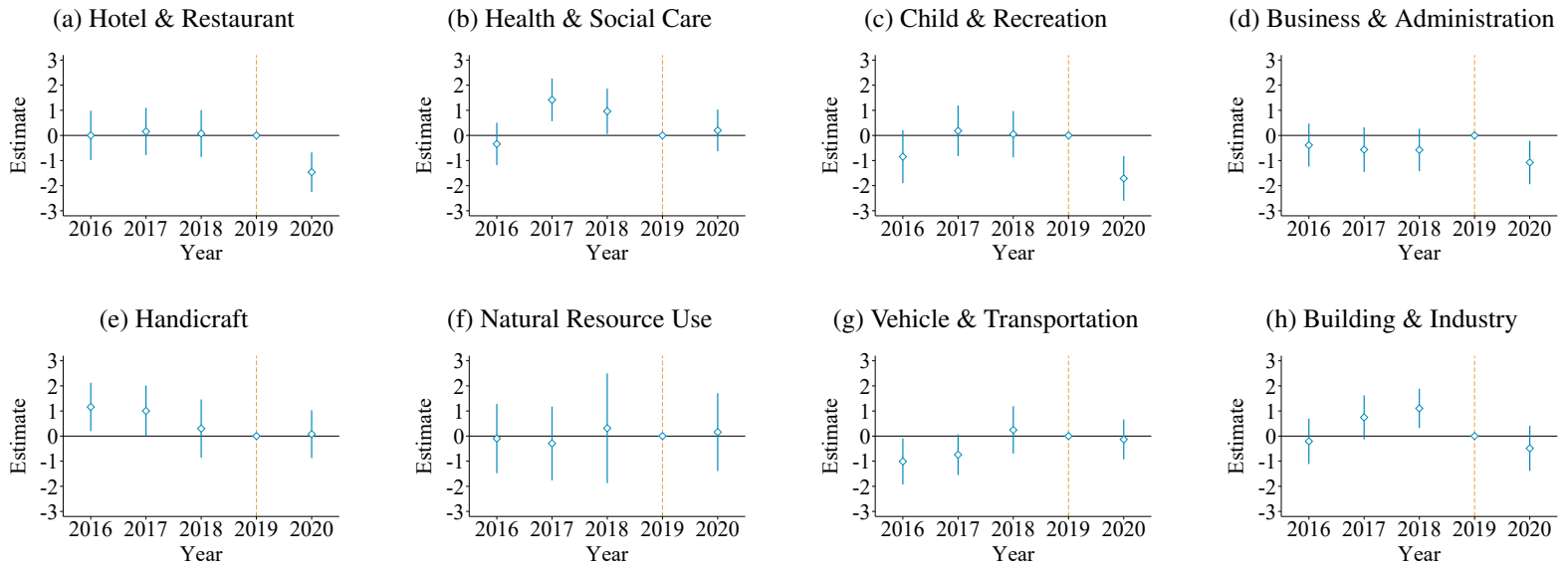
Figure A.3: Estimated effect per program, first-choice applicants.



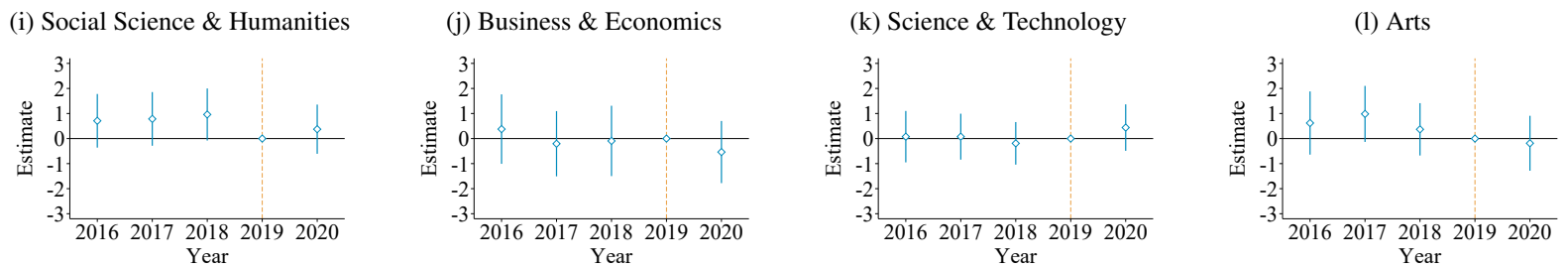
Notes: The regression specification controls for school fixed effects and time-varying school-level controls. The horizontal lines show 95% confidence intervals, with standard errors clustered at the school level. We denote the programs that we pool together for our main analysis with the following symbols: † for Hotel & Restaurant, ‡ for Building & Industry, ¶ for Social Science & Humanities, and § for Natural Science & Technology.

Figure A.4: Event study plots.

Panel A: Vocational programs



Panel B: Academic programs



Notes: Each point plots the estimates of δ_y from Equation 2 run separately by high school program. The vertical bars represent the 95% confidence intervals, clustered at the school level. The dashed orange line denotes the baseline year 2019.