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IFN Working Paper No. 1420, 2021

From Epidemic to Pandemic: Did the COVID-19 Outbreak Affect High School Program Choices in Sweden?

Aino-Maija Aalto, Dagmar Müller and J. Lucas Tilley

From epidemic to pandemic: Did the COVID-19 outbreak affect high school program choices in Sweden?*

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November 29, 2021

Abstract

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 rank programs in order of preference and a final round in which they have full flexibility to alter their preliminary rankings. In 2020, the timing of the two rounds happened to provide a unique pre- and post-crisis snapshot of applicants' preferences for various fields of study. 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 program preferences. We find no change in preferences 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 hotel and restaurant, 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.

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

JEL codes: I20, J24

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1 Introduction

The ongoing COVID-19 pandemic came as an unprecedented shock to labor markets around the world, but certain groups and sectors have suffered the economic fallout to a larger extent. Hard-hit industries like the service sector and travel industry typically employ many labor market entrants, making the economic consequences particularly salient for younger individuals. As a result, the crisis may have affected students' expectations about the employment prospects of different occupations and in turn altered their preferences for different fields of study. While it is well established that economic downturns push students to obtain more education (see, for instance, Betts and McFarland, 1995; Card and Lemieux, 2001; Clark, 2011; Rice, 1999), it is less clear how the business cycle might affect students' choice of major. Some studies find that economic downturns shift students toward higher-paying majors, such as those in STEM fields (Blom et al., 2021; Liu et al., 2018). However, there is also evidence that sector-specific shocks can deter students from generally well-paid or prestigious majors in the affected sectors (Han and Winters, 2020; Weinstein, 2020). As far as the impact of the COVID-19 crisis is concerned, early survey evidence from the US indicates that the pandemic increased college students' likelihood of switching towards majors with higher annual earnings (Aucejo et al., 2020).

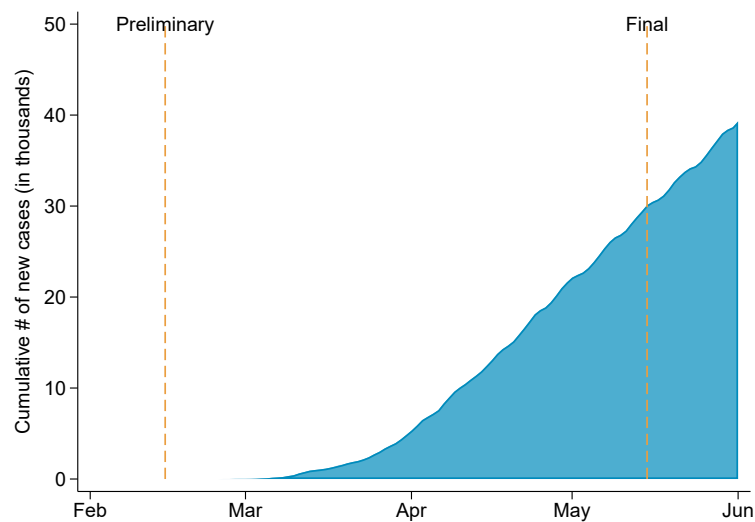
Whereas the existing literature mainly focuses on college-level choices, this paper examines whether students react to labor market conditions when making study choices at an earlier stage of education.¹ We focus on the program choices of high school applicants in Sweden and analyze whether the onset of the COVID-19 crisis altered applicants' preferences for various fields of study. In the Swedish setting, high school admission requires students to apply to field-specific programs that are either academic (e.g., Natural Sciences) or vocational (e.g., Building and Construction) in nature. This decision has important implications for students' future career paths, as labor market prospects differ greatly depending on the high school program one graduates from (SCB, 2017) and there can be long-lasting effects on adult earnings (Dahl et al., 2021). It is also noteworthy that the choice of high school program is made by almost all individuals in a birth cohort, while the choice of college major involves only those

¹Most studies are based on data from the US, where students do not make field-of-study choices until the college level. However, educational systems in many countries require students to make field-of-study choices while still in secondary school.

who are interested to pursue higher education.

To study how program preferences changed in response to the COVID-19 crisis, we use a difference-in-differences strategy exploiting the fact that admission to high school consists of two rounds. In the preliminary round, applicants rank their preferences for specific programs and submit their initial choices to a central admission authority by mid-February. After preliminary admission decisions are released in April, 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 gives us a unique pre- and post-crisis snapshot 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 preferences. However, by the final admission round, the epidemic had turned into a pandemic and spread to Sweden as a health threat and a major shock to the economy. Thus, we can identify the immediate effect of the crisis on program preferences 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 previous years.

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 from almost 700 schools, covering more than 90 percent of applicants nationwide. The ensuing data set includes school-level data for both the preliminary and final admission round in 2020, as well as several years before the crisis. The availability of variables differs somewhat across admission centers, but for each program offered at a school, we observe the program’s capacity (i.e., number of available places) and popularity (i.e., number of applicants who list the program as the top choice on their application) in all cases. The fact that we observe the top-ranked choices on applications is an advantage of our data. We argue that this measure more accurately captures changes in demand for programs as opposed to admission or enrollment outcomes, which might be constrained by the availability of places.

Using this unique data set, we find that the pandemic led to a drop in top-ranked applications to some of the vocational programs. For the Hotel, Tourism and Restaurant program and the Child and Recreation program, the effect is robust throughout and non-trivial, accounting to 7 percent and 6 percent respectively in relation to the mean number of applications to these programs. However, we do not find evidence that any of the academic preparatory programs became more popular as a result of the crisis. As opposed 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, Tourism and 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. Indeed, according to Statistics Sweden, employment in this sector reached a low in April 2020, shortly before final applications had to be submitted. While the decline in applicants to the Child and Recreation program is also in line with reduced labor demand in the corresponding sectors, it is not clear why applicants should react more strongly to worsened employment prospects as compared to other sectors that were similarly or more affected (e.g. the transport sector). However, aggregate statistics on the number of applications to the Child and Recreation program in 2021 point to a persistent decline in popularity of this program that is consistent with our findings for the early stages of the pandemic (Swedish National Agency for Education, 2021).

We perform several additional analyses to verify the robustness of our results and

support our interpretation of the findings. First, 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 from the Swedish National Agency of Education. We confirm that our results are robust when we estimate our model without fixed effects at the school level and instead control for time-varying school-level characteristics. Second, we show that distortions in the supply of available places per program or internship component of vocational programs are unlikely to explain our results.

Our study is the first that we know of to analyze the effects of an economic crisis on program choices at the high school level, several years prior to labor market entry. The findings are important for understanding students' decision making at an early stage of their education process, which is likely to have important implications for career and occupational choices. The choice of high school program affects the vast majority of Swedish students, whereas most other studies only focus on the decision-making process at higher levels of education. In addition to Acton (2021) who focuses on how local employment variations affect field-of-study choices at the 2-year community college level, 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.

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 empirical model, followed by a detailed description of the data in section 4. Section 5 presents our main results followed by a discussion of the parallel trends assumption and robustness checks in Section 6. Section 7 concludes.

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 Supplementary 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 and Recreation, Vehicle and Transport or Hotel and Tourism), as well as six academic programs (e.g., Humanities, Natural Sciences, or Social Sciences). 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), 14 percent of all vocational programs were offered as apprenticeship programs.

Admission to the various high school programs is handled centrally by local admission centers. Admission is grade-based and is organized as a two-round process. Applications for preliminary admission are usually submitted between late January and mid-February depending on the region in which students apply. Application in the first round is not obligatory but highly recommended because high schools use the number of first round applicants for planning the resources for the programs of the following school year; if there were too few applicants to a program it could be decided that the program would not take place that year. In addition, students gain understanding about their possibilities to be accepted to a program with their current grades. At that point, students choose and rank all program-school combinations that they are interested in. Students are typically notified of preliminary admission decisions in late March to mid-April. While final admission is based on the final grades from compulsory school, the preliminary decisions are based on the most recent grades at this time, that is grades from the fall semester of ninth grade. 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) and receive information on 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 choice as is or al-

ter 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/beginning of July. At that time, students get to know what programs they are admitted to based on their final grades from compulsory school and whether they are listed as reserves for a higher-ranked program and the necessary grade-cutoffs for admission. Following the final admission results, students have to decide whether they 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 re-allocated to students highest up on the reserve list.

2.2 Early impact of COVID-19 in Sweden

In a press release from mid-February, the Swedish Public Health Agency's assessment was that the Corona virus was predominantly contained to China and that the risk of community spread in Sweden was very low.² Only one month later, the agency overturned its previous assessment and first restrictions on public gatherings were implemented.³ 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, as well as distancing requirements for restaurants. Furthermore, in March 2020, it was announced that high schools, colleges and universities would shut down for on-site learning and would switch to remote learning.⁴

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

²Public Health Agency of Sweden, press release from February 13, 2020, "No spread of the new Corona virus in Sweden", <https://www.folkhalsomyndigheten.se/nyheter-och-press/nyhetsarkiv/2020/februari/ingen-spridning-av-coronavirus-i-sverige/>, last retrieved October 29, 2021.

³Public 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.

⁴Public 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/laerosaten-och-gymnasieskolor-uppmanas-nu-att-bedriva-distansundervisning/>, last retrieved October 29, 2021.

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 Supplementary 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 percent as compared to the first quarter in 2019. Other particularly hard-hit sectors were Transport and Warehouse (decrease of 46 percent/83 percent in vacancies in the first/second quarter of 2020 as compared to the same quarter in 2019) as well as services in the cultural sector (decrease of 30 percent/74 percent in vacancies in the first/second quarter of 2020 as compared to the same quarter in 2019). Across all sectors, vacancies decreased with 16 percent in the first quarter of 2020 and 52 percent in the second quarter as compared to the corresponding quarter in the previous year.

3 Empirical model

We study how the COVID-19 pandemic affected the program preferences of Swedish high school applicants in 2020. In our setup, we make use of a specific feature of the application process that allows students to submit preliminary applications by mid-February and to alter their preference ranking by mid-May prior to the final admission round in June. The timeline of this two-step process happened to give us a unique pre- and post-crisis snapshot of applicants' program preferences in 2020.

Formally, we use a *difference-in-differences design* (DiD) to study whether the pandemic affected the popularity of various high school programs by analyzing changes in the number of first-hand applicants⁵ between the preliminary and final admission round. In our main specification, we estimate the change in popularity of a program p between the two admission rounds by comparing whether the change between rounds differs in year 2020, due to the Corona pandemic, in comparison to the pooled pre-crisis years. For each program p , we estimate the following specification:

⁵First-hand applicants are applicants who list a certain program as the top preference on their application.

$$Applicants_{psry} = \beta_1 Final_r + \beta_2 Corona_y + \beta_3 Final_r * Corona_y + \gamma_s + \varepsilon_{psry}, \quad (1)$$

where the outcome of interest, $Applicants_{psry}$, is the number of students who apply to program p at high school s in the top choice on their application. The binary variable $Final_r$ takes value one for the final admission round and zero for the preliminary round. The binary variable $Corona_y$ takes value one for the post-pandemic year (2020) and zero for the pre-pandemic years (2016 to 2019). We include school fixed effects, γ_s , to control for local differences. For inference, we also cluster the standard errors at this level. Finally, ε_{psry} is the error term.

In our model, the parameter of interest, β_3 , measures how program p 's popularity changed between the two admission rounds in 2020 in comparison to the pre-crisis years. It captures the causal effect of the pandemic on students' program preferences under the assumption that the change in first-hand applications between the preliminary and final admission round would have been the same in absence of the pandemic. As in all difference-in-differences setups, it is not possible to confirm whether this assumption holds. However, we can lend support to the parallel trend assumption by utilizing a difference-in-differences event study strategy and testing for differential trends in the number of first-hand applicants in the years leading up to the crisis. In section 6.1, we discuss the results of this exercise.

In addition, it is important to lay out some features of our specific setup. Conventional DiD designs typically compare pre- and post-treatment outcomes for different treated and untreated entities (such as different geographic regions). In our setup, the majority of students who apply during the preliminary round (untreated) and final round (treated) are overlapping, which allows us to make comparison across very similar, though not identical units. This means that we can potentially observe many of the same individuals in both the treated as well as in the untreated comparison group. In fact, the units would be close to identical if applications were mandatory during both admission rounds, which is unfortunately not the case. However, we believe that the overlap in treated and untreated units lends further credence to the interpretation that we capture changes in preferences.

3.1 Interpretation of results

We aim to identify how the COVID-19 crisis affected the popularity of different high school programs. While our strategy should correctly identify any changes in the popularity of programs (given that the underlying assumptions hold), there are several potential drivers of such changes.

Applications to high school programs mainly come from ninth grade students who are about to finish compulsory school. Another group of applicants are those who are already enrolled in high school but want to change their program or school. Unfortunately, our data does not allow us to differentiate between these two types of applicants. However, we know that less than five percent of the applicants in a usual year are those already enrolled in a high school program.

There are different components that determine the difference in number of applications between the admission rounds. What we want to capture is the change in preferences for the top choice program between the preliminary and the final round due to the arrival of the pandemic. If switches between top choice programs were the only source of changes between the rounds—that is, if every individual who applied in the preliminary round also applied in the final round—these changes should net to zero in terms of total number of applicants. As the data is aggregated at the school level, we observe aggregate changes in program preferences rather than those of specific individuals. Hence, we do not know what type of programs individual students switch to between the rounds, even though we accurately observe the general popularity of the programs.

The most obvious mechanism is that students who submitted an application during the preliminary admission round shift their program preferences in response to the COVID-19 outbreak. However, we cannot exclude the possibility that changes in applicants can be 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 round⁶, there was a lot of uncertainty about how the Corona crisis would affect firms' ability to organise the practical training that is included in all vocational programs. For instance, there was uncertainty whether training in facilities such as elderly

⁶See the discussion on how the COVID-19 outbreak affected the number of available places per program in Section 6.2.

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 address these concerns formally with the robustness checks in Section 6.2.

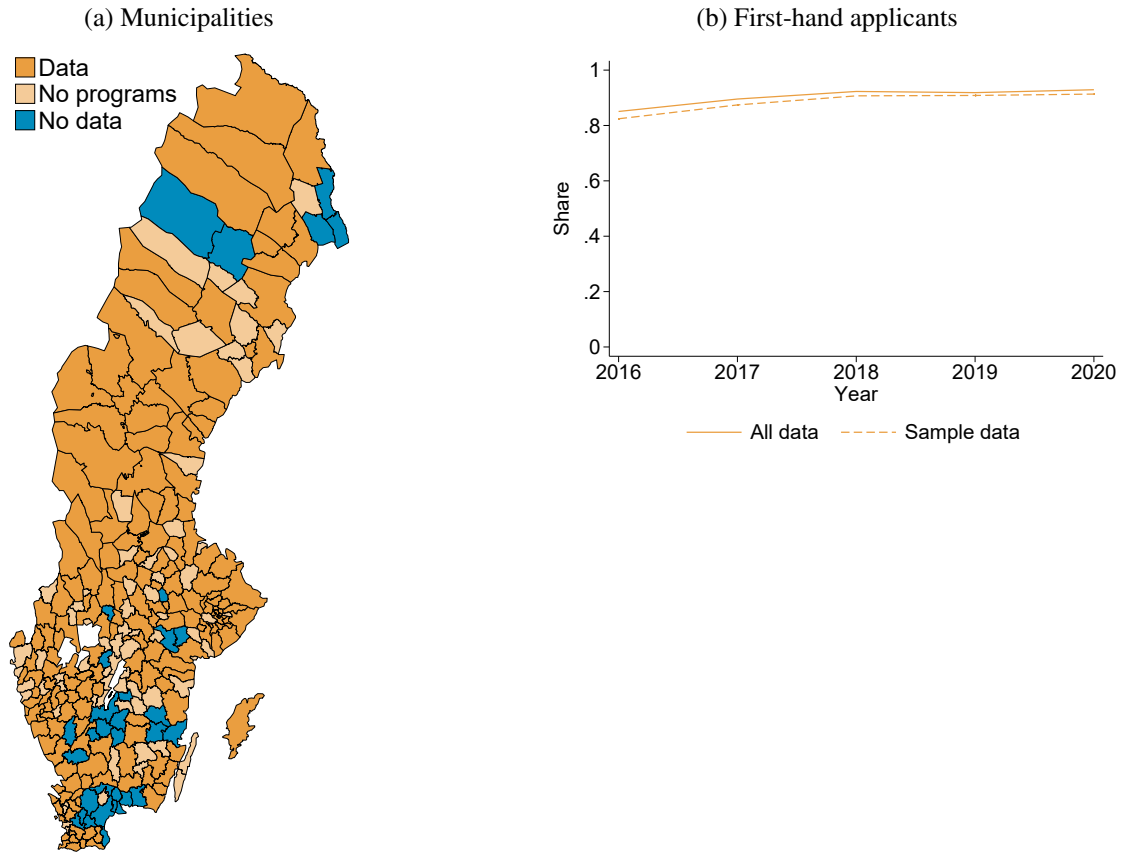
However, there are other potential mechanisms that may explain (part of) the observed changes in the number of applications between the rounds. Since it is not obligatory to submit an application in the preliminary round, even if this is the standard and recommended practice, there are students who only apply in the final round and who thus do not contribute to preliminary round statistics. Our data reflect this fact, showing that the number of applications is always slightly higher in the final round as compared to the preliminary round. A 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 Data and Descriptive Statistics

In order to conduct our study, we collected and digitized public-use data from both the preliminary and final admission rounds for the year 2020, as well as for the four years before the pandemic. The admission data is assembled by local admission centers that cover students who reside in municipalities with a common admission system. However, despite the fact that the admission centers generally collect the same information, publicly available data varies in number of available years and variables. In all cases, the public-use data is aggregated at school level with one observation per program. The data generally includes information about the number of students who have applied to the program as their first choice, the number of students accepted, the number of reserve places, the median grade point average (GPA) among those accepted, and the cutoff GPA if the program had more applicants than spots available.

Figure 2a shows that our school-level data covers the vast majority of Swedish mu-

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 marked in dark orange. Municipalities without high school programs are marked in light orange.

municipalities.⁷ Notably, our admission data includes both rural and urban areas, including the three biggest cities in Sweden (Stockholm, Gothenburg, and Malmö) as well as remote areas in northern Sweden. During our period of study, the collected data covers about 80–90 percent of all high school applications in Sweden.⁸ The dashed line in Figure 2b shows the share for which we have (i) data on both admission rounds within a year and (ii) data in 2020 and at least one year prior. These are restrictions we impose

⁷In most cases, our data covers all high schools in a given municipality.

⁸Table A.4 in the Supplementary Appendix shows descriptive statistics on the number of schools, municipalities and applicants as well as the coverage of applicants for each program separately in the year prior to the pandemic.

for our analysis. Annually, we have close to 700 schools and 3,000 school-program combinations in our data.⁹

Table A.3 in the Supplementary Appendix displays the number of first-hand applicants in our sample data separately for the preliminary and final admission round. In 2020, we record 108,395 first-hand applicants in the preliminary admission round and 112,634 applicants in the final round in our data, of which 34 percent and 35 percent respectively applied to vocational programs. Between 2016 and 2020, the number of total applicants in both rounds increased by about 25 percent, 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, first-hand applications increased by around 5 percent between preliminary and final admission rounds, while the corresponding increase in our sample is less than 4 percent 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 first-hand applicants than the vocational programs. Roughly one third of all first-hand 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 for vocational programs. In order to improve precision and for ease of exposition, we pool several closely related programs together. Hotel, Tourism and Restaurant (3a) shows the pooled trends for the Hotel and Tourism program and the Restaurant and Food program.¹⁰ Construction and Property Maintenance (3g) consists of Building and Construction, Electricity and Energy as well as HVAC and Property Maintenance. The vocational programs are ordered by their orientation towards jobs in the service sector. Figures 3a–3c show the trends for programs that primarily lead to jobs in the service sector, programs that sometimes lead to jobs in the service sector are shown in Figures 3d–3f and programs in Figures 3g–3i rarely lead to jobs in the service

⁹The total number of schools and school-program combinations is shown in Figure A.1 in the Supplementary Appendix over the admission years we have data for.

¹⁰These used to be part of the same program prior to 2011.

Figure 3: Trends in number of first-hand applicants by program in preliminary and final rounds for vocational programs.

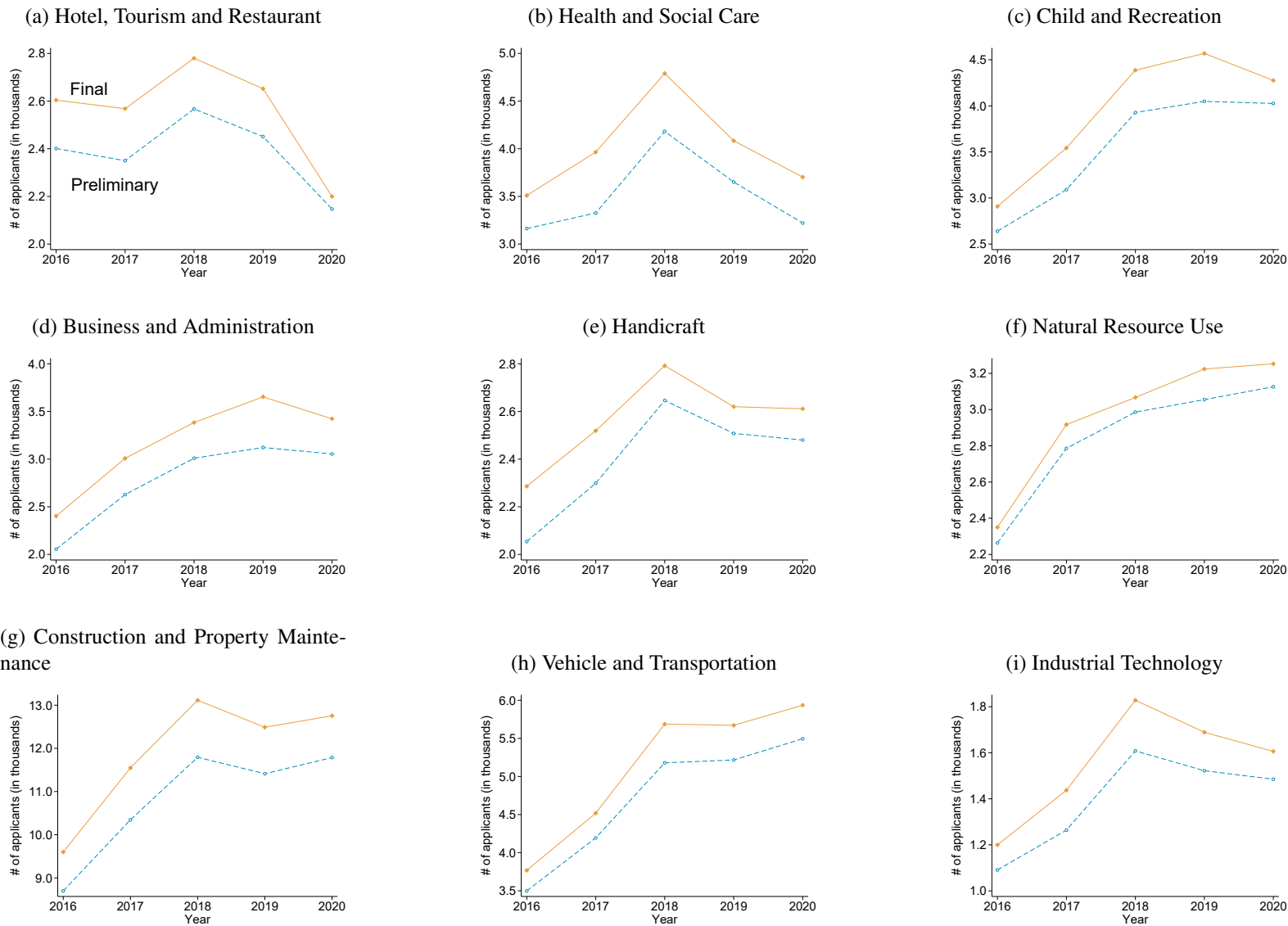
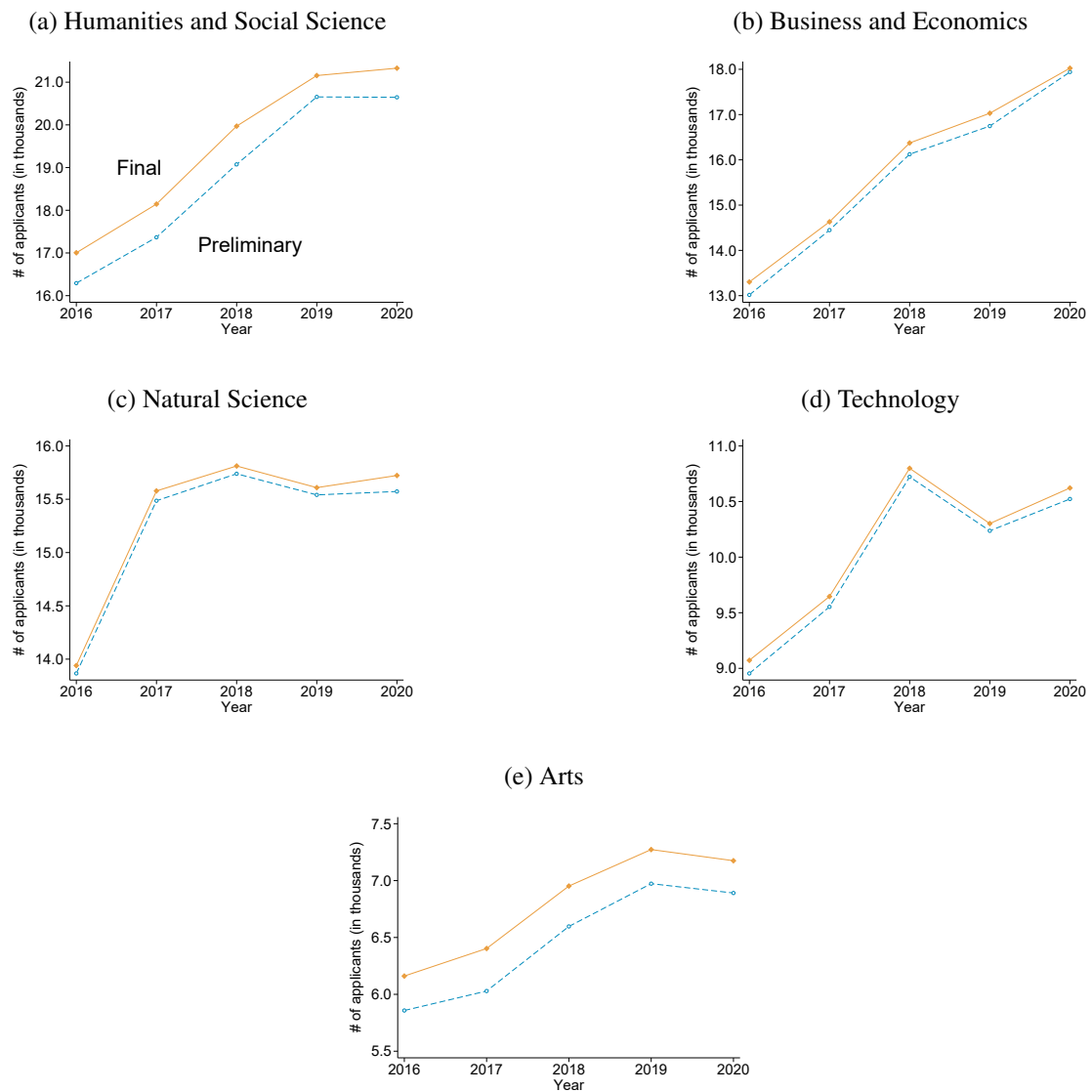


Figure 4: Trends in number of first-hand applicants by program in preliminary and final rounds for academic preparatory programs.



sector.

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 the fact that we have better coverage of applicants in the later years. Importantly, however, for all years we have both preliminary and final round data for each program within a school. Hence, we can conclude that the trends in first-hand applicants in both rounds seem to follow each other very closely up until 2019.

The figures are also indicative of a change in patterns in 2020, suggesting that the decrease in the total number of additional first-hand applicants between the preliminary and final round might be attributable to changes in a few specific programs. Within service-oriented programs, most notably the Hotel, Tourism and Restaurant program as well as the Child and Recreation program, first-choice applications appear to increase less between the preliminary and final round as compared to previous years.

Figure 4 shows that the trends in first-hand applicants to academic programs during the preliminary and final round also follow each other very closely. There is, however, little evidence of a change in patterns in 2020 as compared to the vocational programs.

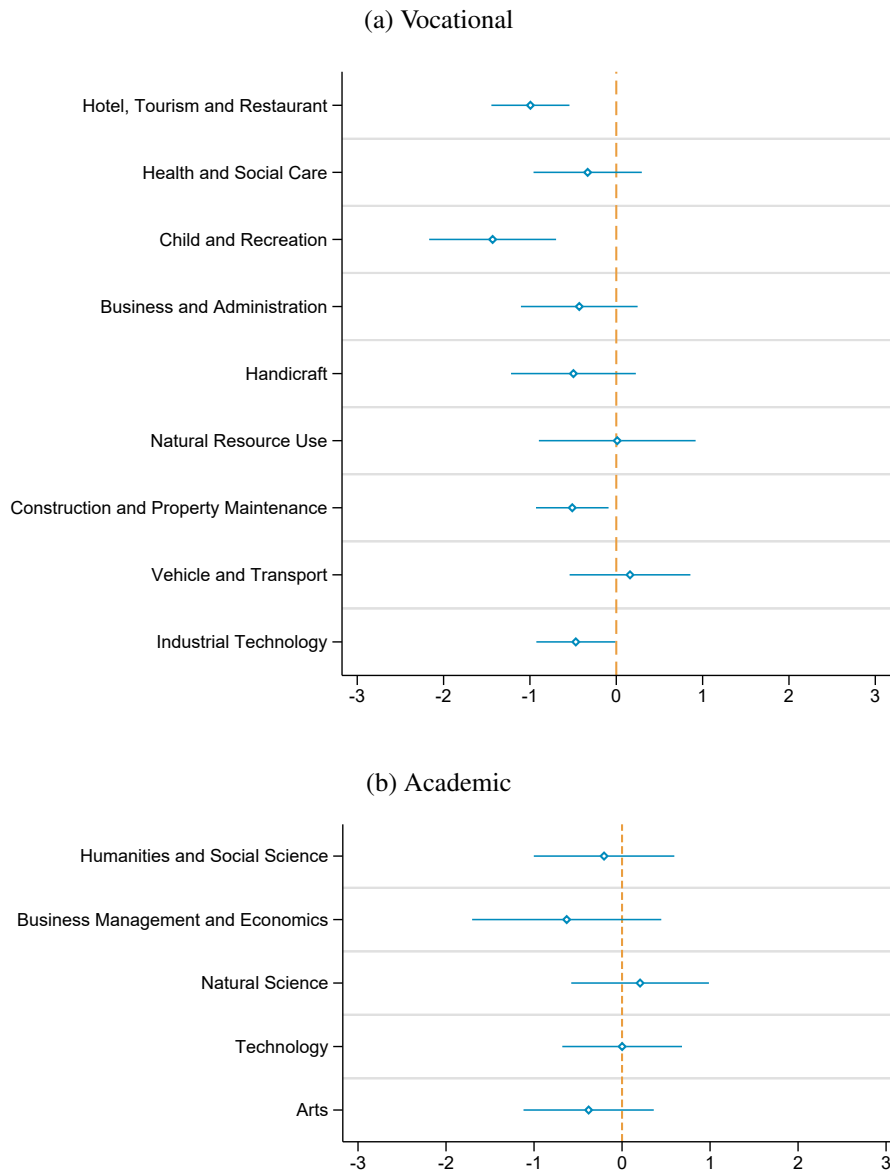
The formal difference-in-differences results will be discussed in the next Section. Formal tests for the parallel-trends assumption are provided in Section 6.1 using a difference-in-differences event-study setup.

5 Results

The trends in the number of first-hand applicants per program in Figure 3 indicated that the arrival of the pandemic to Sweden in spring 2020 might have altered the first-choice preferences of high school applicants. Formally, we analyze the impact of the pandemic on study choices by applying a difference-in-differences design. Figure 5a shows the point estimates and corresponding 95% confidence intervals for each (pooled) vocational program.¹¹ Each program-specific estimate shows the effect of the pandemic on the program's popularity.

¹¹For completeness, Figure A.2a and Figure A.2b in the Supplementary Appendix display the results for each of the 18 national programs individually.

Figure 5: Estimated effect per program.



Notes: The regression specification controls for school fixed effects and standard errors are also clustered at school level. The horizontal lines show 95% confidence intervals. Hotel, Tourism and Restaurant shows the estimated effect for the pooled programs Hotel and Tourism and Restaurant Management and Food. Construction and Property Maintenance shows the estimated effect for the pooled programs Building and Construction, Electricity and Energy and HVAC and Property Maintenance. Humanities and Social Sciences show that the estimated effect for the pooled programs Humanities and Social Science.

The results imply that the pandemic mainly had a negative effect on the popularity of vocational programs. However, we only find significant negative effects in four programs: Hotel, Tourism and Restaurant; Child and Recreation; Construction and Property Maintenance; and Industrial Technology. In order to interpret the size of the effects, we need to compare the effect size to the mean number of applicants in the analysis years prior to the pandemic (2016-2019). The estimated effect of the pandemic on applications to the Hotel, Tourism and Restaurant program corresponds to a decrease of 1.0 in the average number of applications per school and program, explaining 7 percent of the variation in the average number of applications to the Hotel, Tourism and Restaurant program and is thus of economic importance. In the Child and Recreation program, first-hand applications decreased by 1.4 applications (roughly 6 percent) per school and program, as compared to previous years.

While the estimated effects for the Hotel, Tourism and Restaurant and Child and Recreation are notable in size and robust throughout different specifications and robustness checks, the results for Construction and Property Maintenance and Industrial Technology are more sensitive. First-hand applications to Construction and Property Maintenance as well as Industrial Technology decreased slightly with 0.5 applications each (about 2 percent and 4 percent respectively). However, a closer look at the non-pooled results in Figure A.2a in the Supplementary Appendix shows that the results cease to be significant when we estimate the effects separately for the three programs that are part of Construction and Property Maintenance, while the estimate for Industrial Technology is only borderline significant (p-value 0.05) and sensitive towards different robustness checks (see even the discussion in Section 6).

Interestingly, we do not observe that the decrease in first-hand applications to the above-named vocational programs is mirrored by an increase in applications to other vocational programs. One possibility would be 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 5b 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.

This result suggests that students who opt out of vocational programs do not perceive academic programs as an alternative. Instead, they might enroll in alternative forms of education or enter the labor market directly.

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

6 Robustness

6.1 Assessing the parallel trend assumptions

Our main difference-in-differences model relies on the assumption that the change in first-hand applicants 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 by applying a difference-in-differences event study design. The advantage of this strategy is that we obtain a parameter estimate of the difference in applicants between the preliminary and final round for each sample year relative to our base year. We estimate the following specification:

$$Applicants_{psry} = \sum_{y=2016}^{2018} \beta_y \cdot Final_r + \beta_{2020} \cdot Final_r + \gamma_s + \varepsilon_{psry}, \quad (2)$$

where the parameter of interest, β_{2020} , captures the effect of the pandemic on program p 's popularity between the two admission rounds in comparison to the base year. We set the year 2019 as the base year because this is the last year prior to the pandemic. If the parallel trends assumption holds, we would expect the estimates prior to 2019 to be close to zero.

The results for vocational and academic programs are shown in Figures 6 and Figure 7 respectively and generally lend support for the parallel trends assumption.

Figure 6: Event study, vocational programs.

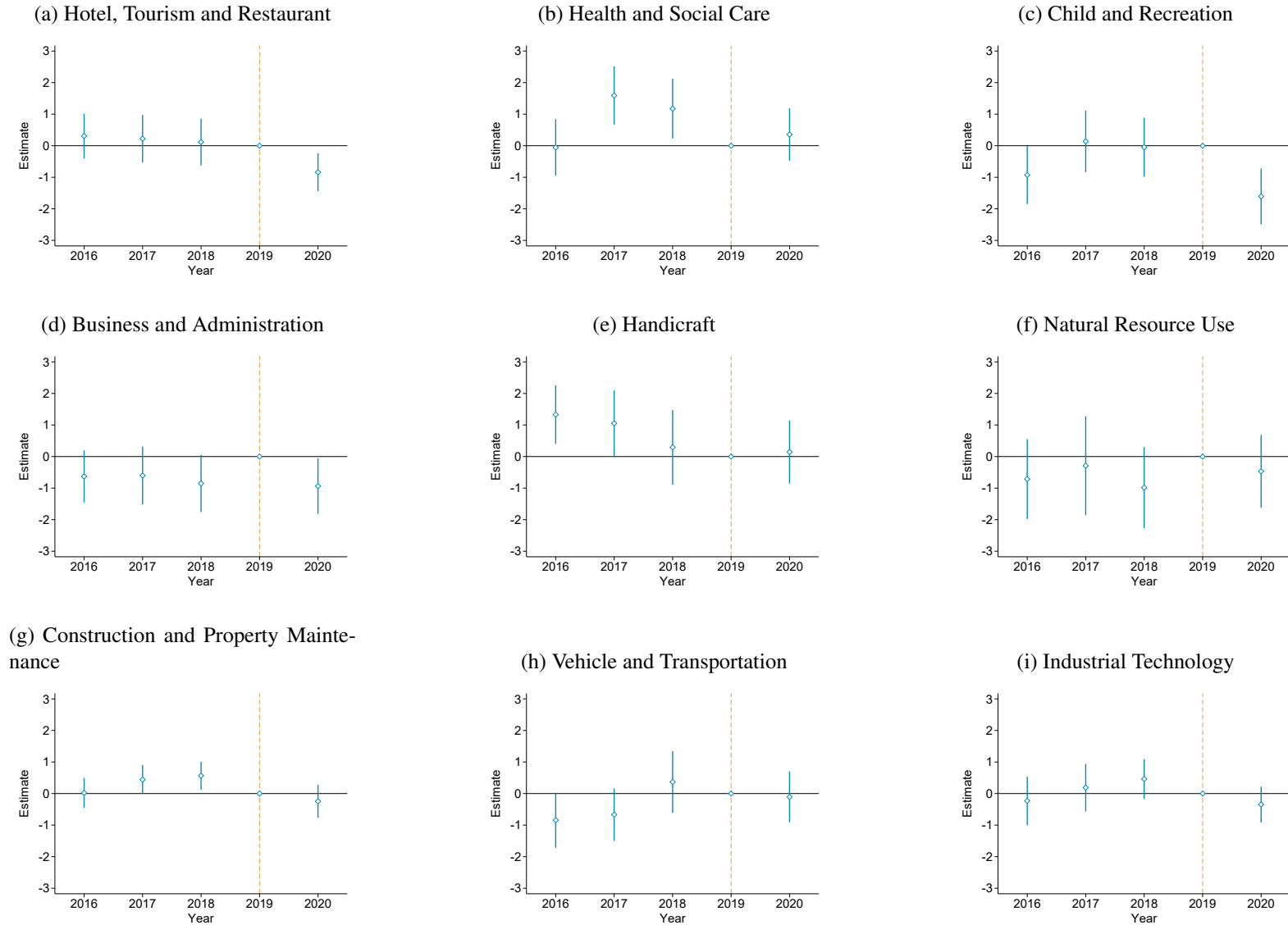
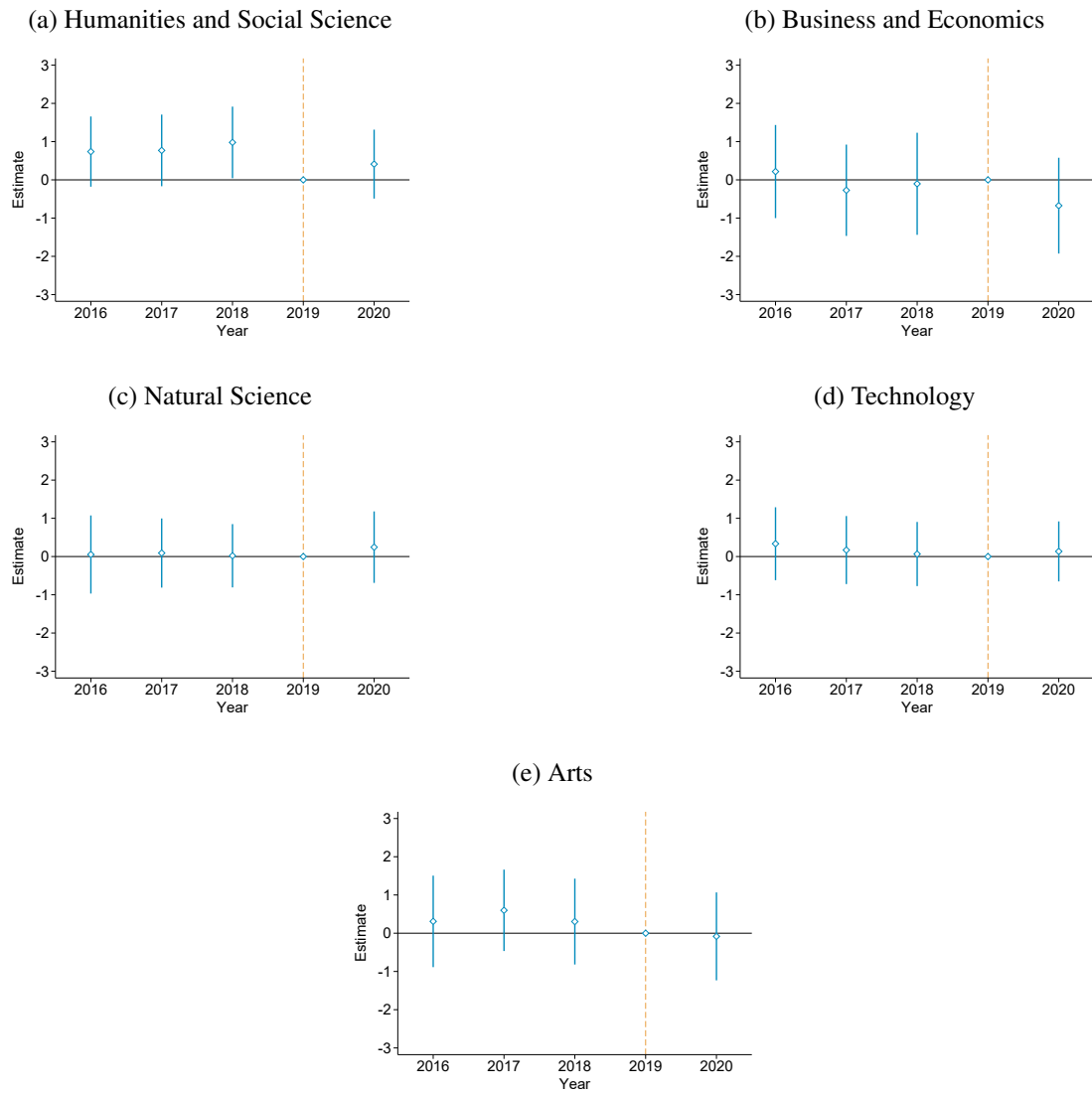


Figure 7: Event study, academic programs.



In line with our main results, we see a negative effect of the pandemic on the number of first-hand applicants in Hotel, Tourism and Restaurant and Child and Recreation. For Construction and Property Maintenance as well as Industrial Technology, we find that our results are sensitive in the event-study specification. While we still find negative effects, they are slightly smaller in magnitude than previously and cease to be significant, suggesting that the choice of base year seems to matter. In the case of Construction and Property Management, there is also a concern that the pre-trends might not be parallel in 2017 and 2018. Importantly, with the exception of the Health and Social Care and Handicraft program, there is no evidence that the parameter estimates prior to 2019 are significantly different from zero for any of the other vocational programs. For the larger academic programs, all estimates prior to 2019 are precisely estimated and close to zero. Given that some of the pre-COVID-19 estimates for Health and Social Care and the Handicraft program are statistically significantly different from zero, we cannot exclude the possibility that other factors might explain the results for these programs.

The positive estimates in 2017 and 2018 in the Health Care program also coincide with an increase in the number of male applicants and an increase in applicants who do 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 regulation, 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. It is possible that the increase in applicants in 2017 and 2018 can be (partly) explained by the large number of young, mainly male, refugees who tried to gain asylum.

6.2 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 popularity of programs (demand side). Such supply-side distortions could 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

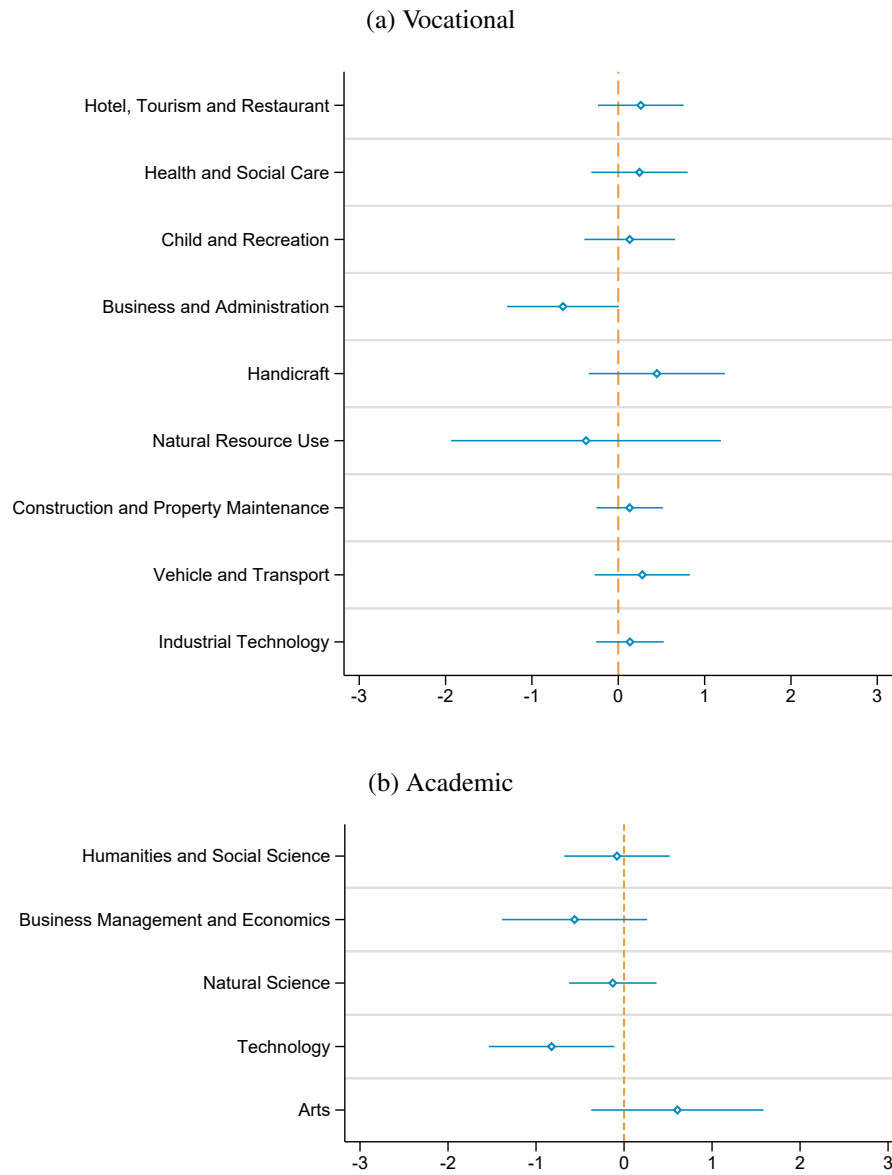
certain programs by adjusting the number of available places. While such supply-side adjustments would be a bigger concern if we would look at enrollment instead of applications, it is still possible that knowledge about changes in the availability of places had an effect on students' application decisions. Thus, a likely scenario that would affect the interpretation of our results would occur if students changed their programs choices as they, rightly or wrongly, believed that adjustments in the number of available places affected the likelihood of being admitted to certain programs.

Fortunately, we can address this concern by estimating how the COVID-19 pandemic affected the number of available places within a program in our DiD setup. To be precise, we estimate Equation 1, using $Places_{psry}$, that is the number of available places per program p at high school s , as an outcome. The results are displayed in Figure 8a (vocational programs) and Figure 8b (academic programs).

There is nothing that points toward that changes in the availability of places can explain the effects for the vocational programs, even though the effect on Business and Administration is close to being significant. The estimates for the other 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. The only academic program that appears to be affected by supply-side changes is the Technology program, for which we see a very slight reduction in available places of -0.8, corresponding to only a slight decrease of less than 2 percent in relation to the mean number of places. Given the zero effect on the number of applications in Figure 5b, the slight reduction in available places is unlikely to mask bigger changes in applications to this program.

Another concern is that 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 training due to both economic and health concerns connected to taking in new personnel. This was likely a bigger concern in programs that require close contact between individuals, such as Child and 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 percent) consists of on-the-job training. About 14 percent of the vocational programs in our data are

Figure 8: Estimated effect on number of available places per program.



Notes: The regression specification controls for school fixed effects and standard errors are also clustered at school level. The horizontal lines show 95% confidence intervals. Hotel, Tourism and Restaurant shows the estimated effect for the pooled programs Hotel and Tourism and Restaurant Management and Food. Construction and Property Maintenance shows the estimated effect for the pooled programs Building and Construction, Electricity and Energy and HVAC and Property Maintenance. Humanities and Social Sciences show that the estimated effect for the pooled programs Humanities and Social Science.

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 apprenticeships.¹²

The results without these programs are shown in Figure 9. The effects are very similar to our main results and confirm the existence of a negative effect on the popularity of the programs Hotel, Tourism and Restaurant, Child and Recreation as well as Construction and Property Maintenance. Thus, these results do not appear to be driven by supply-side considerations with regard to the feasibility of apprenticeships programs during the pandemic. However, the negative estimate for Industrial Technology is no longer significant and even smaller in size after excluding apprenticeship programs.

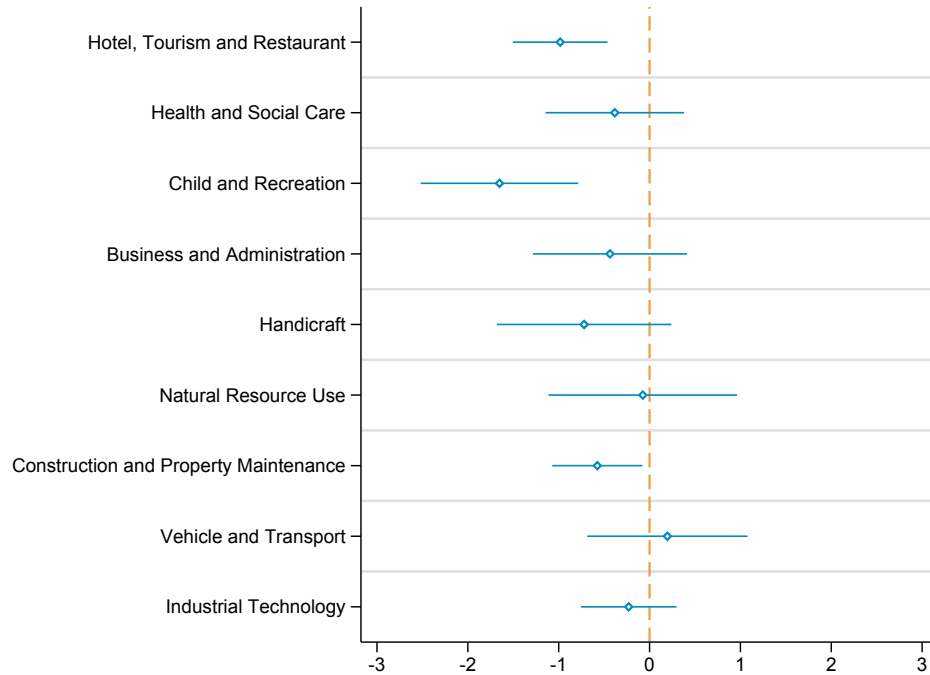
6.3 Controlling for time-varying school-level characteristics

In our main specification in Equation 1, we include school fixed effects in order to control for school characteristics that are constant over time. However, it is also possible that changes in the student composition over time could lead to diverging application patterns. We verify our results by estimating two specifications of Equation 1. In the first specification, we estimate our DiD-model without fixed effects at the school level (Figures A.3a and A.3b in the Supplementary Appendix), before introducing a set of time-varying school-level controls in the second specification (Figures A.4a and A.4b in the Supplementary Appendix). Instead of exploiting variation within the same school (and program) over rounds and time, the identifying variation 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 (see Figures A.3a for the vocational programs and A.3b for the academic programs in the Supplementary Appendix).

In order to introduce school-level controls, we combine our collected data with information from the Swedish National Agency for Education on school-level characteristics. While we would ideally like to include information about the composition of all applicants to a school (data which is not available), we revert to using information of the actual student composition at a school that applicants applied to as a proxy. In Figures

¹²Since apprenticeship programs account for only 14 percent of all vocational programs, we do not have enough precision to investigate the effect on apprenticeship programs separately.

Figure 9: Estimated effect per program, vocational, w/o apprenticeship programs.



Notes: The regression specification controls for school fixed effects and standard errors are also clustered at school level. The horizontal lines show 95% confidence intervals. Hotel and Tourism and Restaurant shows the estimated effect for the pooled programs Hotel and Tourism and Restaurant Management and Food. Construction and Property Maintenance shows the estimated effect for the pooled programs Building and Construction, Electricity and Energy and HVAC and Property Maintenance.

A.4a and A.4b in the Supplementary Appendix, we introduce controls for the share of foreign students, the share of highly-educated parents with post-secondary education as well as the share of female students per school. The results are extremely similar to the ones obtained in our main specification. The inclusion of any additional controls has no discernible effect on the results, suggesting that changes in the composition of schools over time are unlikely to explain our results.

7 Conclusions

In this paper, we contribute to the literature with evidence on how the COVID-19 pandemic altered the program preferences of high school applicants in Sweden. We implement a difference-in-differences strategy to identify the effect of the pandemic on program preferences and show that the pandemic led to a decline in applications to vocational programs, while academic programs were unaffected. We find the largest decline in applicants to the Hotel, Tourism and Restaurant programs, which is incidentally the sector in which employment was affected most during the pandemic. There is also evidence of a similarly large relative decline in first-choice applicants to the Child and Recreation program. The decline in Hotel, Tourism and Restaurant is consistent with the interpretation that students respond to sector-specific changes in labor market prospects when choosing their field of study. While the reduced popularity in the Child and Recreation program is also in line with reduced labor demand in that sector, it is possible that factors other than labor market considerations might contribute to the decline in applicants (for instance, increased risk of infection due to close contact with children). Our aggregated data does not allow us to disentangle the exact mechanisms behind the observed changes in program choices, and we leave this question for future analysis.

Another open question is whether the immediate shifts that we observe in program choices are long-lasting or whether students might switch back to hard-hit industries immediately after the COVID-19 crisis is over. There is already some suggestive evidence that the effects may persist. Descriptive aggregate statistics of the final choices of Swedish high school students one year into the crisis (2021) indicate that, in line with our findings, the programs in Hotel and Tourism as well as Child and Recreation remain less popular than prior to the COVID-19 crisis, while Health and Social Care seem to have gained in popularity (Swedish National Agency for Education, 2021).

Finally, future research could pin down whether these changes in the popularity of programs lead to potential 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.

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A Supplementary Appendix

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

Vocational	Academic Preparatory
Child and Recreation	Business Management and Economics
Building and Construction	Arts
Electricity and Energy	Humanities
Vehicle and Transport	Natural Science
Business and Administration	Social Science
Handicraft	Technology
Hotel and Tourism	
Industrial Technology	
Natural Resource Use	
Restaurant Management and Food	
HVAC and Property Maintenance	
Health and Social Care	

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	35,366	38,866	29,767	18,628	-16%	-52%

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

Table A.3: Descriptive statistics by program types

	Admission year				
	2016	2017	2018	2019	2020
Total first-hand applicants					
Preliminary round	85,852	95,167	106,154	107,139	108,395
Final round	90,107	100,426	111,735	112,019	112,634
Share vocational					
Preliminary round	0.325	0.339	0.357	0.345	0.340
Final round	0.340	0.359	0.374	0.363	0.353

Table A.4: Descriptive statistics by program, year 2019.

	Schools	Municipalities	Applicants	Coverage
Vocational programs				
Hotel and Tourism	75	58	988	0.901
Restaurant Management and Food	96	80	1,664	0.897
Health and Social Care	171	127	4,084	0.856
Child and Recreation	167	121	4,569	0.884
Business and Administration	163	109	3,653	0.866
Handicraft	116	63	2,620	0.896
Natural Resource Use	83	60	3,224	0.885
Building and Construction	183	128	5,203	0.893
Electricity and Energy	210	131	5,826	0.897
HVAC and Property Maintenance	90	62	1,460	0.894
Vehicle and Transport	169	127	5,671	0.882
Industrial Technology	123	102	1,689	0.898
Academic programs				
Humanities	34	26	684	0.994
Social Science	376	161	20,471	0.924
Business Management and Economics	298	144	17,029	0.932
Natural Science	321	157	15,609	0.925
Technology	238	141	10,302	0.902
Arts	174	88	7,273	0.926
All programs	682	182	112,019	0.909

Figure A.1: Number of schools and school-program combinations.

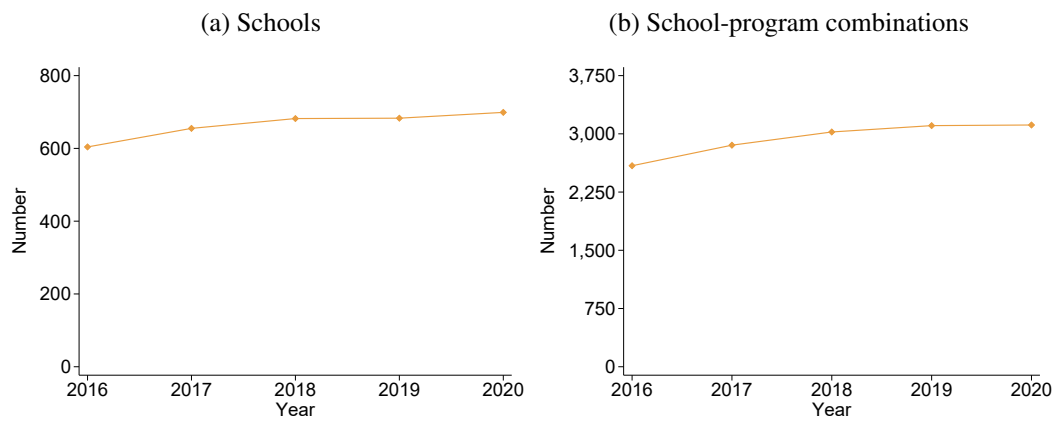
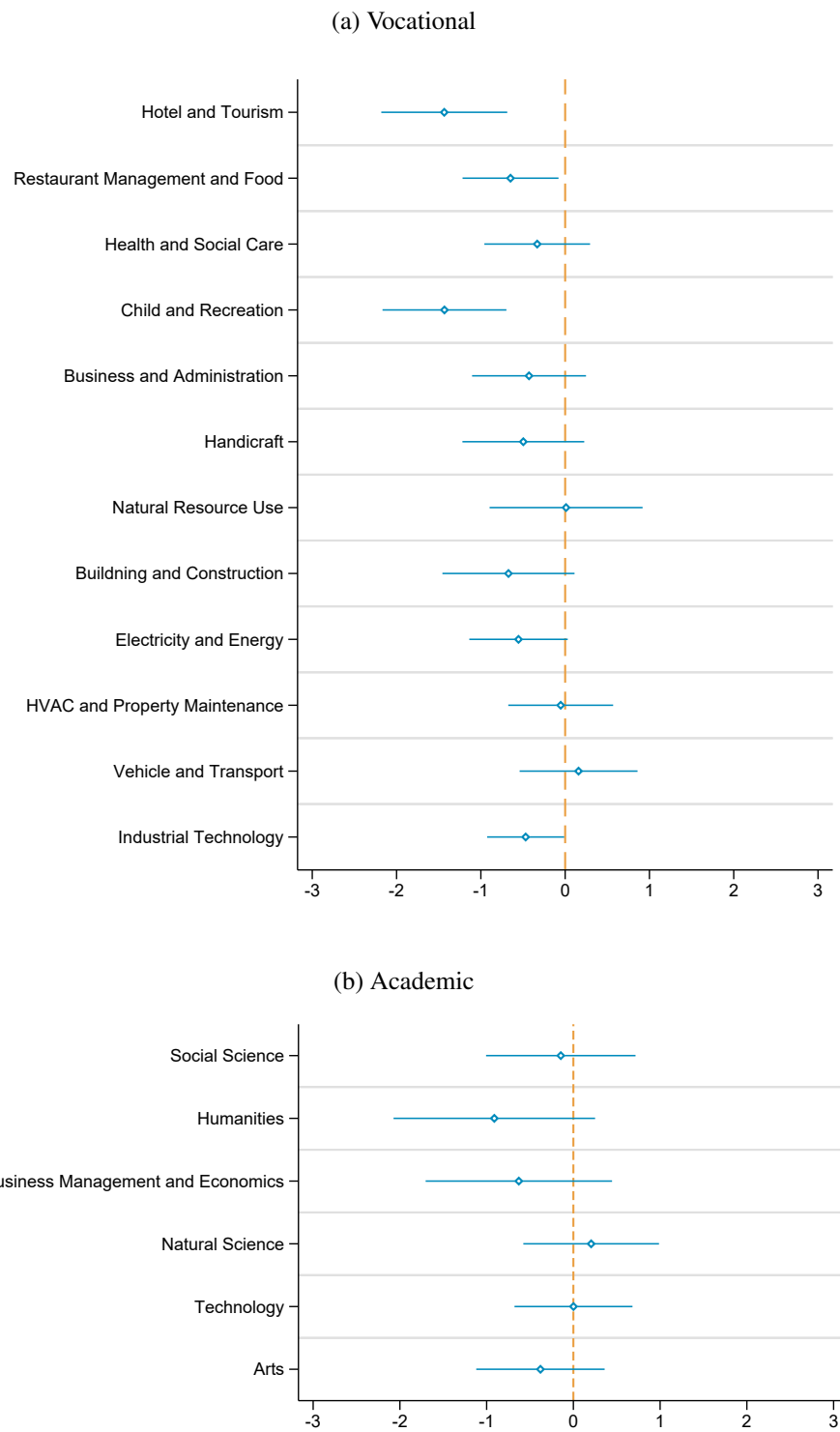
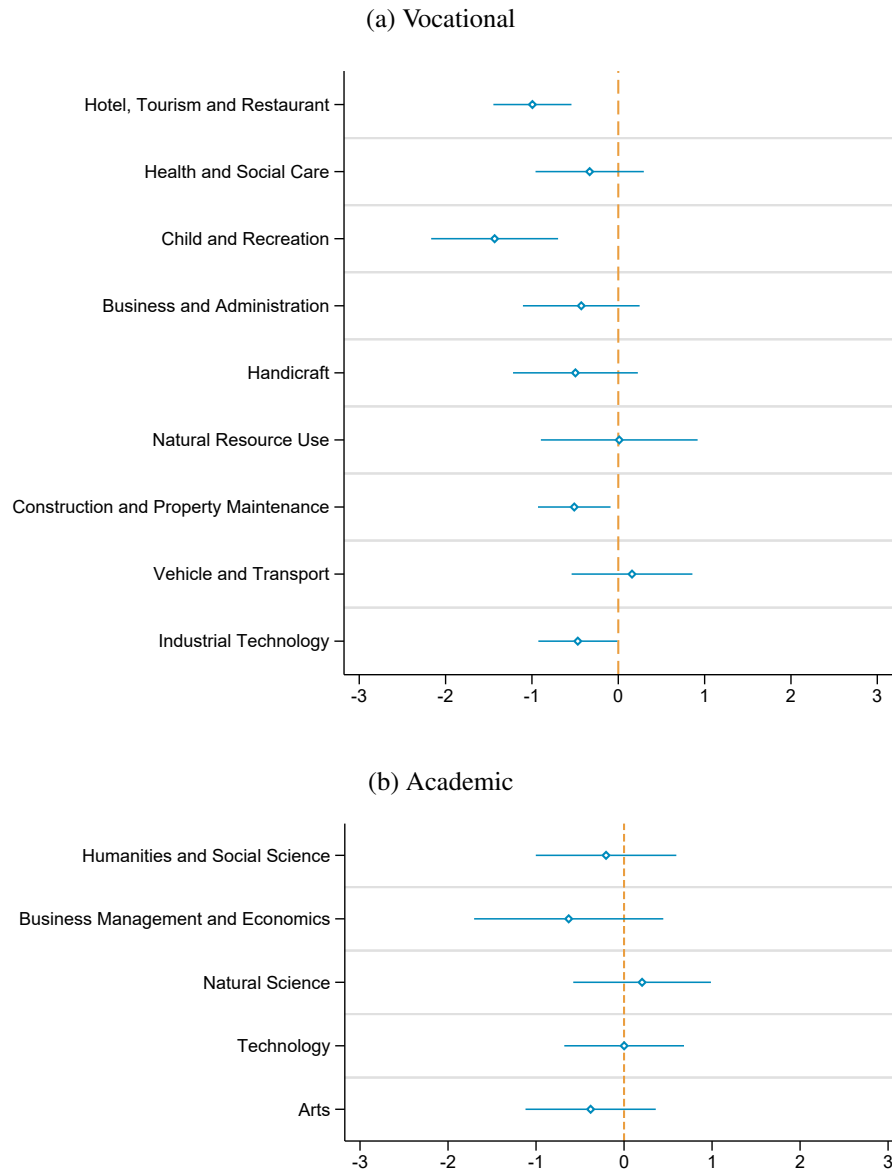


Figure A.2: Estimated effect per program, no pooling.



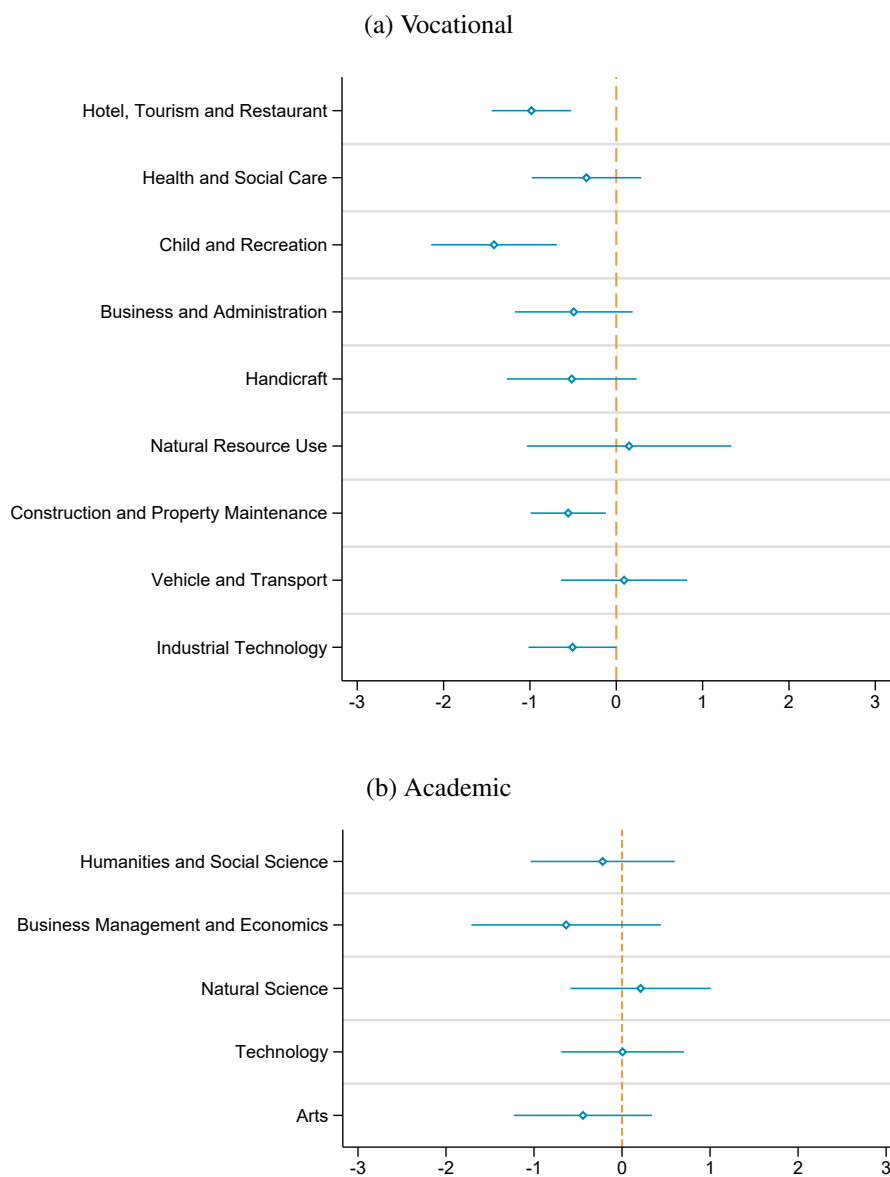
Notes: The regression specification controls for school fixed effects and standard errors are also clustered at school level. The horizontal lines show 95% confidence intervals.

Figure A.3: Estimated effect per program, no FE.



Notes: Standard errors are clustered at school level. The horizontal lines show 95% confidence intervals. Hotel, Tourism and Restaurant shows the estimated effect for the pooled programs Hotel and Tourism and Restaurant Management and Food. Construction and Property Maintenance shows the estimated effect for the pooled programs Building and Construction, Electricity and Energy and HVAC and Property Maintenance. Humanities and Social Sciences show that the estimated effect for the pooled programs Humanities and Social Science.

Figure A.4: Estimated effect per program, no FE, school-level controls.



Notes: The regression specification controls for following school level characteristics: share of foreign born, share of parents with higher education and share of female students. Standard errors are clustered at school level. The horizontal lines show 95% confidence intervals. Hotel, Tourism and Restaurant shows the estimated effect for the pooled programs Hotel and Tourism and Restaurant Management and Food. Construction and Property Maintenance shows the estimated effect for the pooled programs Building and Construction, Electricity and Energy and HVAC and Property Maintenance. Humanities and Social Sciences show that the estimated effect for the pooled programs Humanities and Social Science.