



Distance and choice of field: Evidence from a Norwegian college expansion reform

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Abstract:

How can geographical proximity to college explain field of study choices? We empirically address this question using the major expansion of university colleges in Norway in the second half of the twentieth century, when 33 new education institutions were established in areas that did not previously have any institutions for higher education. Our findings indicate that take-up of the relevant educations (nursing, engineering and business administration) increased substantially with the establishment of new colleges. However, we do not find evidence of an increase in education on earnings capacity overall, suggesting that the new colleges shifted individuals on the intensive rather than extensive margin, between education tracks of similar length. We discuss challenges related to the estimation of education choices in a population that often started higher education late, well into their twenties, and also document substantial gender differences in the take-up of different higher education opportunities.

Keywords: University access, Gender differences, Field of study, Geospatial variation

JEL classification: D31; I23; J62

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Sammendrag

Hvordan henger utdanningsvalg sammen med hvilke utdanningstilbud som finnes i nærheten av der man bor? I denne artikkelen studerer vi hvordan valg av utdanningsfelt henger sammen med etableringen av nye høyskoler i Norge på andre halvdel av 1900-tallet. Fra 1955 til 1989 ble totalt 33 nye høyskoler etablert i regioner hvor det tidligere ikke hadde vært slike høyere utdanningstilbud. Vi finner at valg av de typer utdanninger som i størst grad var omfattet av reformen (sykepleier, ingeniør og økonomi/administrasjon) økte betydelig der tilbudene ble etablert. Vi finner imidlertid ingen indikasjon på økning i utdanningslengde, noe som tyder på at endringen i befolkningens utdanningssammensetning som følge av høyskolereformen skjedde på den intensive marginen ved at valg av utdanningsfelt ble endret heller enn på den ekstensive marginen. I artikkelen gjennomgår vi også utfordringer knyttet til estimering av utdanningsvalg i en befolkning som ofte startet høyere utdanning ved relativt høy alder, godt opp i 20-årene, og vi gjør grundige analyser for å utelukke at lokaliseringen av de nye høyskolene er korrelert med kommunekjennetegn.

Tydelige kjønnsforskjeller

Vi finner betydelige kjønnsforskjeller i valg av utdanning. Sykepleierutdanning blir i hovedsak valgt av kvinner, mens det er menn som velger ingeniørutdanning. Når det gjelder økonomi/administrasjon er det derimot ingen vesentlig forskjell på tvers av kjønn når det gjelder utdanningsvalg, men vi finner at menn som ble eksponert for et utdanningstilbud i slike fag har høyere lønn senere i livet enn sammenliknbare kvinner. Dette kan skyldes at, for gitt grad, ender menn og kvinner i ulike yrker. Blant dem med grad i økonomi/administrasjon, er det langt flere menn enn kvinner i lederposisjoner og langt flere kvinner enn menn i generelle kontoryrker hvor lønnen gjerne er lavere.

Kontrafaktiske utfall

Vi analyserer også hvilke utdanningsfelt individene ville ha valgt i fravær av de nye utdannings-tilbudene. Det gjør vi ved å se på nedgang i andre utdanningsfelt for de som ble eksponert for de nye høyskolene. Det kontrafaktiske utfallet for kvinner som velger sykepleie utdanning ser i stor grad ut til å være lærerutdanning, mens for menn er dette andre teknologiske fag, eller økonomi/administrasjon. Det samme mønsteret gjelder også for økonomi/administrasjon: Menns kontrafaktiske utfall er ingeniør utdanning og kvinners (dog noe mindre tydelig) er lærerutdanning og utdanning innenfor humaniora- og samfunnsvitenskapelige fag.

1 Introduction

Geography and place are important in shaping opportunity (Chetty et al., 2014; Markussen and Roed, 2018), and living near a higher education institution is associated with higher educational attainment (Card, 1995; Helland and Heggen 2018). However, less is known about how proximity to education institution shapes the choice of field of study, such as choices between different career paths with similar educational lengths. In this paper, we study how geographical expansion of higher education in Norway during the second half of the twentieth century affected outcomes - in terms of field of study, education length and income as adult - for individuals growing up close to the new college establishments. Between 1955 and 1989 a total of 33 new university colleges were established in Norway, with wide geographical dispersion, predominantly offering degrees in nursing, engineering, teaching and business administration. We find that the expansion induced local youth to undertake education locally, but at the expense of degrees offered further away. We find no increase in overall educational attainment, and with the exception of business administration, no effects on income. The evidence points in the direction of lateral switches between fields; for example, more women in affected areas studied nursing, but at the expense of fewer choosing a teacher education. As expected, education choices for this period are highly gendered, with men showing no change in behavior when nursing educations are established and women similarly not responding to the establishment of engineering colleges.

Although the college premium is important in explaining wage inequality, it is by now well-documented that field of study also matters for labour market outcomes (Altonji et al., 2012; Hastings et al., 2013; Kirkeboen et al., 2016). The expansion of higher education in Norway offers a unique setting to study whether the distance to college has an effect on field of study choices as the expansion happened field-wise; engineering, nursing and business administration colleges were established throughout the country at different times.¹ Using this staggered implementation avoids

¹We do not study teaching in this paper, mainly because teaching colleges were more widely established before the

endogeneity issues related to individuals with high education aspirations for their children locating close to colleges.

As in other Western countries, higher education in Norway was subject to a very rapid expansion beginning in the 1960s, and developing through the 1970s and 1980s. For example, the share of people born in 1950 who ever obtain a college degree is almost twice as high as for those born in 1945 (3.95 vs 7.23 per cent, respectively). This expansion has later been called “the transition from elite to mass higher education”(Trow, 1970). Outside the major cities in Norway, education opportunities and the level of higher education was very low prior to 1950. The increase in education institutions across the whole country increased the take-up of the degrees provided at the newly established colleges. Figure 1 shows that the overall share of each cohort that obtained a degree in nursing and engineering increased substantially for cohorts born between 1950 and 1960.² The increase in business continued for cohorts born between 1960 and 1970. These increases coincide with this regionally staggered expansion of colleges and schools, on which we base our identification strategy.

The locations of the colleges were a result of a complex political process aiming to improve access to education across the country. As the locations were determined by the central government, debates in the parliament reveal that local suitability or demand were not prerequisites when politicians decided where to place the new colleges. Instead, the location of the colleges was chosen with the purpose of providing each of Norway’s nineteen counties colleges offering degrees in nursing, engineering, teaching and business administration (Johnsen, 1999; Ottoesen, 1969; Knutsen, 2017)³.

An opening of a new college may induce prospective students to shift away from colleges

reform. See Footnote 3 below.

²Other historical sources tell similar stories. The documentation of censuses 1960, 1970 and 1980 (Vassenden, 1987) contains statistics on education. In the 1960 census education from type of institution was registered. In the 1970 and 1980- census, type of education was registered. As percentage of the population, the share of nurses increased from 0,59 % in 1960 to 0,98 % in 1970 and 1,3 % in 1980 . The share of college engineers increased from 0,5% in 1960 to approximately 1 % in 1980. Hence, the number of nurses and college engineers doubled as a percentage of the population between 1960 and 1980.

³Most regions already had a teaching college, therefore we do not consider teaching as a part of the reform. Teaching education was also not much debated in the parliament in debates regarding new collegelocations.

further away, as well as increase local college enrolment if the cost constraint is binding in the decision to attend college. Using rich administrative data on education and earnings as well as censuses going back to 1960, we are able to track field of study, earnings and the municipality of residence in a given year for the entire Norwegian population.

Our findings indicate that young adults residing within commuting distance to a new college show a significant rate of take-up of the new education opportunities. However, men do not change their behaviour in response to nursing degrees being offered nearby, and women do not respond to engineering degrees. This fits in with the general pattern seen in Norway and elsewhere, women often choose health related fields and work in the public sector, while men choose technical or scientific fields. For business and administration, the take up rates do not differ across men and women.

We find no increase in the overall educational attainment, implying that the increase in the degrees offered, came at the expense of field of study not offered locally. We find that the establishment of a nursing college is associated with a decrease in the propensity to do a teaching degree for women. For men, establishment of new engineering colleges is negatively correlated with take-ups of degrees in other technological fields and business administration. Furthermore, the business administration degree was for men chosen at the expense of engineering, while for women, although less clear, the increase in this degree came at the expense of teaching and social sciences.

While higher education is associated with higher earnings, the effect of a shift in field is not clear. If people choose field according to their comparative advantage as found in (Kirkeboen et al., 2016), decreasing the cost of particular fields may induce people to undertake degrees they do not have an advantage in. We find few pronounced changes in mid-life income and labor market participation, suggesting that the changes in field of study for the treated population did not result in higher earnings. However business administration is one exception: While we find zero or small positive changes in male wages, we do observe a decrease in the labor market participation for women living in areas that got access to a college with business administration. We discuss two plausible explanations for this result. First, to what extent did the establishment of a college induce

women to remain in their home municipality? If they did, they could have missed out on better labor market opportunities elsewhere. Second, did the business administration degree offer particularly bad labor market opportunities for women? We find some support for both explanations: The college establishments had an effect in retaining women in their home municipality, while we find a smaller effect on men. Also, the mapping from degree to occupation differs across gender: A business administration degree is associated with manager positions for men, while women concentrate in occupations that tend to pay less, such as general office workers. This finding is in line with a recent study by Andersen et al. (2020) who, using discontinuities that randomize applicants near admission cut-offs, find that fields with larger gender gaps causally reduce female earnings in Denmark.

If we were to expect that the reform contributed to decreased income inequality for those affected, we would have expected it to have a greater impact on individuals whose parents did not have higher education as the cost constraint associated with moving away to go to college may in particular be binding for this group. We find instead that the reform affected individual with high and low educated mothers similarly in terms of take-up. An exception is engineering which mostly increased take-up for men whose mothers had higher education. For women, our findings suggest that access to a nursing college is associated with a lower propensity to work full-time.⁴

To ensure that our results are driven by the college openings and not other confounding factors, we control for municipality level time trends in our main specification and show that our results are robust to a range of different geographical definitions of college access. In addition, we follow a previous study by Bhuller et al. (2017) in showing that municipality level characteristics in 1950 and 1960 cannot predict reform year.

Although policy-makers aimed to increase access of higher education, we conclude that the people growing up in the area of a new college seem not to have changed their study length. Such policies may have a larger effect in settings where moving is more costly and education scholar-

⁴In Norway 45 % of nurses in 2011 worked part-time according to Statistics Norway: <https://www.ssb.no/arbeid-og-lonn/artikler-og-publikasjoner/stort-omfang-av-deltidsarbeid>.

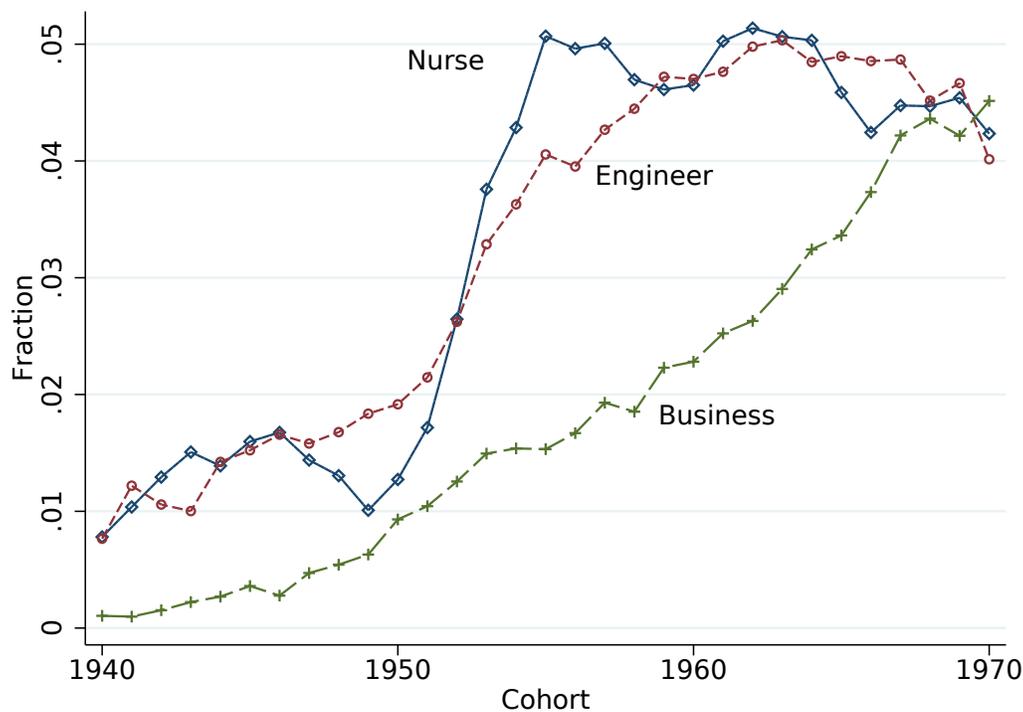


Figure 1. Fraction with a degree in nursing, engineering and business in Norway, by birth cohorts 1940-1973.

ships less generous than in the case of Norway in this period.⁵ However, there seems to be room for policy-makers who want to change the composition of the local workforce, to do so through locally offering specific field of study. More generally, our results question the benefits of local college access and the importance of distance determining whether or not people undertake higher education.

The rest of the paper is structured as follows. Section 2 describes the institutional setting and the history of the educational expansion, Section 3 explains our data and empirical strategy and Section 4 presents our main findings on degree take-up and labor market outcomes.

⁵In this period a majority of students were eligible for living-away-from-home scholarship. More on this in the next section. Lapid (2017), finds that new university openings in California, a setting where students finance their studies mostly by loans, parent’s contributions and student employment, increase local college attendance.

2 Institutional settings and background

2.1 Expansion of higher education in Norway

In the middle of the twentieth century, the level of higher education in Norway was low. In the 1950 Census, only 35 percent of men and 26 percent of women had any education above elementary school.⁶ As mentioned above, geographical background was important in predicting education in Norway, but the educational advantage by geographical centrality was reduced considerably in the period after 1960 (Lindbekk, 1998). One reason was that in the period after World War 2, policies that aimed at equalizing social and economic differences across the country gained wide popular support. One such intervention was the establishment of higher education institutions across the country, and throughout the 1950s and 1960s Norway experienced a rapid increase in university colleges whose location was decided politically, and was not necessarily referring to local demands or resources.

Regional university college boards (so called “regionale høgskolestyrer”) were established in order to integrate the most common majors at the university college level - such as teaching, engineering, nursing, business and administration - at the regional level. In Norway, university colleges, for simplicity denoted “colleges” in the remainder of this paper, is the designation of a higher educational institution that traditionally has offered short, career-oriented types of education at or below what today is know as bachelor level. Traditionally, a characteristic difference between colleges and universities has also been that colleges do not conduct academic research. Previously, degrees in higher education, mostly university degrees, had only been offered in some of the major cities. Politically it was therefore emphasized that these new higher education institutions should be spread around the country. In other words, the expansion of colleges was to a large extent a regional policy measure (Norwegian Ministry of Education, 1975).

At the time Norway was divided into thirteen educational regions, and the new colleges were distributed with the intention that that all regions should, have a university college.⁷ After the

⁶This information is obtained here: <https://www.ssb.no/befolkning/artikler-og-publikasjoner/si-meg-har-du-studert>

⁷Each region consisted of one or two of Norway’s nineteen counties, grouped in the following way: 1: Troms and

expansion most counties offered a degree in nursing, teaching, engineering or business and administration. Before the expansion of university colleges, only the three largest cities (Oslo, Bergen and Trondheim) and central municipalities located close to the biggest cities offered higher education at the university- og university college level.⁸ . None of the engineering colleges were located in the north of Norway. The number of colleges outside of the biggest cities increased substantially after World War 2 with the educational expansion: 9 new nursing colleges, 11 new engineering colleges and 13 regional colleges were built. Figure 3 shows maps of the location of new colleges (established after 1940) offering a degree in nursing, engineering and business and administration. Before 1969, very few education institutions in Norway offered a college degree in business and administration⁹. Approaching 1990 each county/district was covered. Appendix A Table A1 gives an exact overview over year of establishment and localization. A thorough description of the establishment of these education institutions is given in Appendix A and in Knutsen (2017). Figure A.1 in the Appendix shows a map of colleges established before 1940.

While the number of students enrolled in the universities remained the same, there was a substantial increase in the number of students enrolled in the colleges (Johnsen, 1999). The increase is illustrated in Figure 2. Only 2.2 percent of the 1940 birth cohort had a college degree. This share increased to almost 7 percent for the 1950 cohort and 12 percent for the 1970 birth cohort. The first increase in this share, from the late 1940 birth cohort to the 1950 birth cohort, coincides with the increase in nursing and engineering degrees for the same birth cohorts (cf. figure 1). The second increase coincides with the establishments of the business and administration degree from 1969 and onwards.

Tertiary education in Norway relies mainly upon public funding. Public universities and col-

1: Finnmark, 2: Nordland, 3: Nord- and Sør-Trøndelag, 4: Møre og Romsdal, 5: Sogn og Fjordane, 6: Hordaland, 7: Rogaland, 8: Aust- and Vest-Agder 9: Telemark, 10: Oppland and Hedmark, 11: Oslo and Akershus, 12: Vestfold 13: Østfold.

⁸In the period before 1940, there were ten nursing colleges and 7 engineering schools in Norway. In addition to being located in Oslo, Bergen and Trondheim, they were located in Stavanger, Skien/Porsgrunn, Tønsberg, Bodø, Lillestrøm, Grimstad and Follo.

⁹The new curriculum of the college degree in business and administration was based on the same degree at Norges Handelshøyskole in Bergen. In addition, Bedriftsøkonomisk institutt, a private institution, offered evening courses in bigger cities and correspondence courses in similar subjects.

leges have very low or no tuition fees and funding to cover living expenses is available to everyone, especially after loans and scholarships ceased to be means-tested on parental income in 1968. In 1969, 97 per cent of those that applied, were granted a scholarship and loan (Ministry of Education, 1969).¹⁰ Thus, the private cost of education was mainly the opportunity cost of not working and potentially that of moving to a place where a college is located.

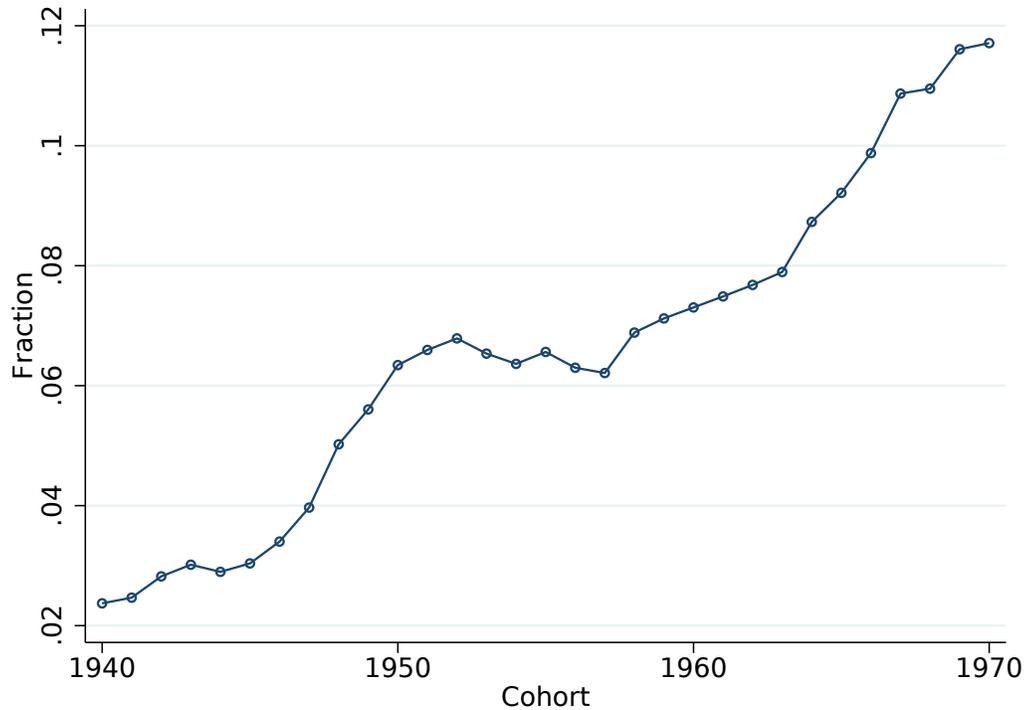


Figure 2. The fraction with a college degree in Norway, by birth cohort

2.2 The Norwegian education system

Education in Norway consists of mandatory elementary school and 3 years of high school consisting of academic or vocational tracks.¹¹ Today a high school diploma from the academic track is required to enter higher education. However, in the time period subject to this study, three years in

¹⁰Lånekassen, the public institution that gives loans and scholarships to students was created in 1948, but was strictly means-tested in the early years. Towards the end of the fifties the number of students receiving scholarships increased as the means-testing criteria were relaxed and new education institutions were eligible. In the early 1960's the majority of students were receiving loan and scholarship (Røseth, 2003).

¹¹Before “Gymnas” (study-oriented) and “Yrkesskole” (vocation-oriented), in the 1970's harmonized to “Videregående skole” (a unified system, but with separate tracks).

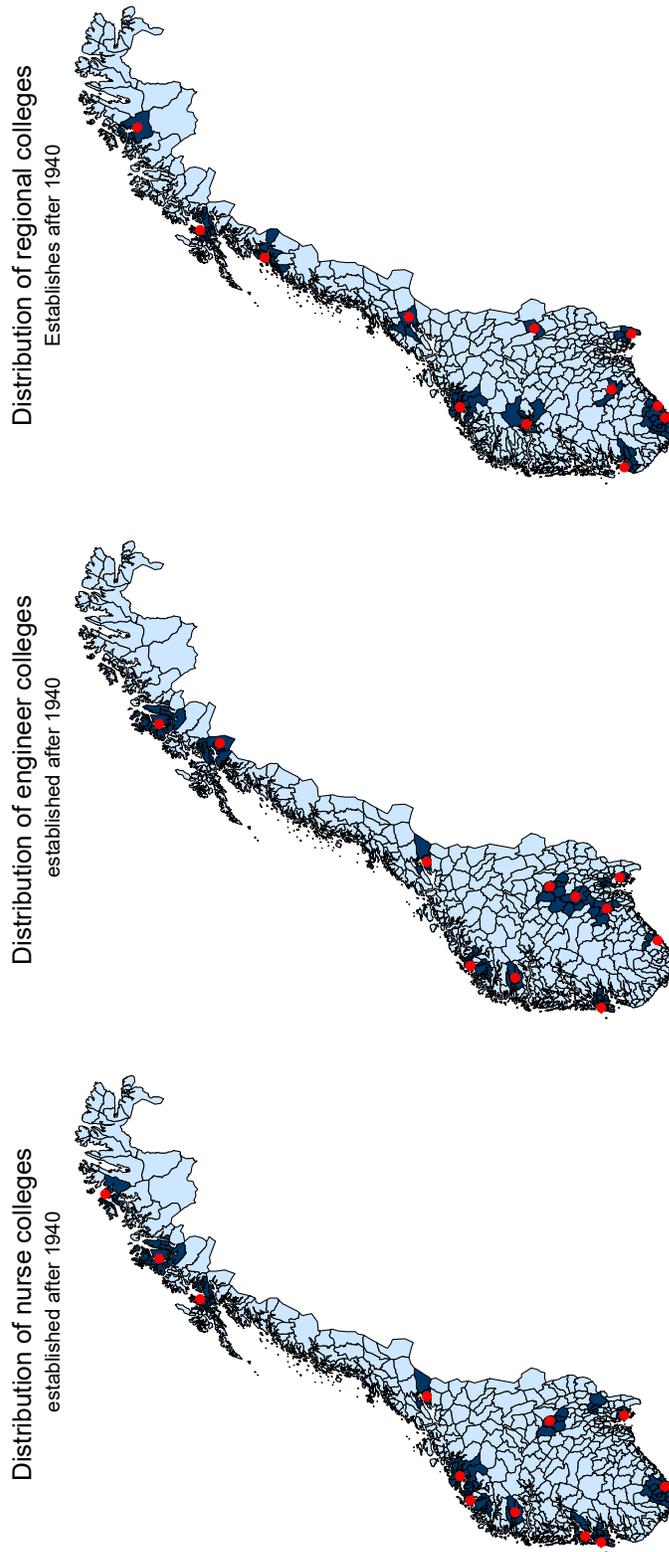


Figure 3. Location of nursing, engineering and regional colleges established after 1940, with commuting zones highlighted

high school was relatively uncommon, and a high school diploma was not a formal requirement for entering higher education in nursing and engineering. As high school became increasingly common, some types of educations such as engineering and nursing changed the entry criteria. In 1977 (engineer) and 1981 (nurse) the entry criteria changed from a compulsory schooling diploma to a high school diploma. However, most students entering nursing schools had finished high school also before the entry criteria changed (Aamodt, 1982). In our sample the median age when enrolling in nursing- and engineering school is respectively 22 and 20. For the business and administration track, that was first introduced in 1969, a high school diploma has always been the required in order to enrol.

Moreover, there was a tendency, particular for Norway, in the decades after WW2 that youth entered the work force after elementary school (7-9 years) and came back into the education system later, in particular to colleges and vocational schools (Bostad, 2007). OECD identifies this as a feature that makes the Norwegian tertiary system distinctive even today: students are somewhat older when they commence and graduate than in many other countries (Clark and Sohlman, 2009). In the period we study, there was therefore no clear starting age for higher education.

2.3 Business administration degrees

As a part of the geographic expansion of higher education, the so-called “Ottoesen committee” suggested to open a new type of educational institution, namely the regional colleges (Ottoesen, 1969).¹² By creating these colleges, the committee wanted to make access to higher education more ‘fair’ as well as increase the number of college degree holders. The parliament decided to establish one such college in each county that did not have a university at the time. This was realized for all counties with the exception of the smallest one, Vestfold..¹³ The location of the regional colleges was decided by the parliament, where this was subject to debate. Even though the potential for student recruitment and professional environment were supposed to be critical

¹²The practicalities if the roll-out is described in White paper (St. prp.) nr 136 (1968-69), “Om prøvedrift med distriktshøgskolar [About the trial phase with regional colleges]”

¹³At the time there were universities in the following counties: Oslo, Sør-Trøndelag (in Trondheim), Hordaland (in Bergen) and Troms (a university was established in Tromsø in 1968).

to the placement of the colleges, debates in the parliament suggest that the idea of equalization of educational opportunities across regions was more important. The minister of education, Kjell Bondevik, later regretted that regional political considerations had been decisive for the location of colleges (Johnsen, 1999). An example of how such regional political considerations looked like in practice is the placement of a college in Bø, a village with 4000 inhabitants in Telemark, which was chosen at the expense of other cities in the same county such as Skien and Porsgrunn with much larger populations.

A new 2-year degree in business and administration (“økonomi og administrasjon”) was introduced with the establishment of the regional colleges and its curriculum was determined by the central government¹⁴: About sixty percent of the curriculum were to consist of methodological subjects such as mathematics, statistics, economics and an introduction to information technology, the remaining forty percent in applied subjects such as accounting and human resources. The idea was that the degree-holders could enter management and leader positions in local firms. In this way, the new colleges were to support economic growth in the regions in which they were located. The business administration degree turned out to be by far the most popular degree at the new colleges, in terms of number of students (Johnsen, 1999).

2.4 Nursing and engineering schools

Nurses in Norway organized early; in 1912 the Norwegian Nurses Association was established. From the beginning they campaigned for a better and standardized training of nurses. As a result the education of nurses was a 3-year degree starting some places already in the 1920's and national standardized exams were introduced in the 1950's together with a national authorization of nurses (Norwegian Nurse Association, 2017). Nursing was at the level of upper secondary school until it was upgraded to university college in 1981. Hence, until 1981, a compulsory schooling diploma was required in order to enrol in a nurse school, while later a diploma from upper secondary school (videregående) was needed. Individuals in our sample are born between 1940 and 1970, hence for a

¹⁴All regional colleges, with an exception of the one in Lillehammer, Oppland, offered this degree from the start.

vast majority of our sample, compulsory schooling was sufficient. After the compulsory schooling reform the graduation age from compulsory schooling was 16. However, in practice most that were enrolled in the nursing schools had completed high school even though this was not a formal requirement (Aamodt, 1982). Nursing was and continues to be a profession dominated by women. In the data, as much as 89 % of nursing degree holders are women. Average age for initiating a nursing degree for the 1940-1973 cohorts is around 23 years¹⁵.

Before 1977, the engineering schools were equivalent to technical schools, and a high school diploma was not necessary in order to enter. In 1962, the education in technical schools increased from 1 to 3 years.¹⁶ In 1977, the schools changed name from technical schools to engineering colleges and the criteria for entry changed; now a high school diploma was a prerequisite. With a male percentage of 88, engineering is almost exactly as dominated by men as nursing is by women.

3 Data, sample selection and empirical strategy

The analysis in this paper is based on data from Norwegian administrative registries, which can be linked together using a personal identification number. This unique number was established as part of the National Population Register in 1964, and includes all individuals alive and resident in Norway at some point since that year.

3.1 Population data, municipal structure and commuting zones

Our sample consists of all individuals born between 1940 and 1973 residing in Norway at the age of 16 and not subsequently emigrating. The data set is constructed from the population register, tax records and the educational register, based on the individual ID numbers. The population registry has recorded the municipality of residence for all individuals each year. We base our analysis on the

¹⁵The individual-level micro data used in the analysis only has information on the year of education for those who started their degree after 1974. When upgraded to a university college, the average age changes slightly, from 22 years between 1974- 1980 to 23,6 between 1981-1990. There is no significant difference in average starting age between treated and untreated regions.

¹⁶For students who had completed the science track (*realartium/naturfagartium*) in high school, the study length was 2 years.

municipality borders of 1980.¹⁷ We use the municipality in which an individual lives at the age of 16 as recorded in the population registry. For those born before 1949, who are 15 years or older when the population register was established in 1964, we use their municipality of residence recorded in the 1960 census which is the only earlier source available. Individuals with unknown municipality (around 3 per cent, mostly immigrants) and persons registered as living outside Norway and are not included in the analysis.

In the 1970 Census, all individuals in Norway reported their municipality of residence as well as municipality of work. Based on this information, we construct commuting zones around the relevant regional colleges. A *municipality_i* is defined as being within commuting distance of an education institution in municipality *j* if at least 1% of the employed individuals in *municipality_i* work in *municipality_j*. For the few cases where a municipality falls within the commuting region of two educational programs, starting the same type of education at different times, the earliest date of start up is used. The maps of commuting zones of nursing and engineering colleges are shown in Figure 3 where the commuting zones around a college are represented by a shaded area.

3.2 Education

The primary data used to assess the effect of the college establishments on degree attainment are collected from the Norwegian Education Data Base (NUDB). This data base contains individual-level data on all education completed by 1970 and education undertaken from 1970 and onward (Vangen, 2007). Education is coded at a high level of detail (six digits in the NUS classification) so that we are able to identify particular educational fields. Fields that have changed levels, such as nursing, are coded with the level they have today. In general, the educational institution is not reported for individuals completing their education before 1999.¹⁸

NUDB has every education initiated linked to a national identity number. This implies that we

¹⁷A large number of Norwegian municipalities were merged with their neighbouring municipalities in the 1960s, bringing total number down from 747 to 450. We base our analysis on the 1980 municipality borders and use a conversion based on information in the 1960-census in order to find define the 1980-municipality of an individual in 1960 (i.e. all individuals are observed each year, but the granularity of information for each individual does not change over time. None of the policies discussed in this table were set at the municipal level.

¹⁸For further documentation of the educational database, see Vangen (2007)

can track every individual's educational career. As a result we have in most cases more than one observation per individual. In order to obtain a data set with one observation per individual, the data is collapsed on the highest attempted education level and the respective field/degree we are looking at. This means that we also include individuals with for example a nursing degree who for example continued on a master program at a later stage.

A challenge with the education database is that it lacks education data for around 120 000 individuals, most of these born before 1958. Around half of them are registered in NUDB, but without information on education. This is resolved using the censuses from 1960 and 1970 which also contains information on level and type of education. For these individuals highest achieved education in 1970 is used and the fields subject to this study are re-coded.¹⁹

3.3 *Income*

Information of individual-level income is obtained from the tax authorities. These registers are available from 1967 and onward. As a measure of income we use total pre-tax income from work.²⁰ In order to obtain a meaningful estimate of earning differences we keep work-experience roughly fixed, and measure the mean income for each individual in our sample when they are between ages 35-40. At this age, most individuals have finished their education and have entered the labour market.

We observe many individuals (about 22 000) with missing or zero income at the age of 35 to 40 years, two thirds of these are women. Before 1977 the value missing is more frequent and was used for those that had zero income. Therefore, we insert zero income for all with missing income who are living in Norway at the age of 35-40. Thus individuals not registered as residents in Norway

¹⁹Complete educational histories are not available in the census data, only highest achieved education. Moreover, partially finished educations may not be visible in the census data. This could in principle introduce a comparison problem. However, based on the data that we do have, there is little reason to believe that a substantial number of individuals completed a nursing degree and then subsequently a higher, unrelated degree before 1970. An earlier version of this paper conducted analyses using only the education database data and found qualitatively similar results to those we report here.

²⁰More specifically income that gives entitlement to pension [“pensjonsgivende inntekt”]. This includes mostly income from work, but also benefits that enter as a substitute to income from work such as paid sick leave and temporary disability benefits

at this age (due to emigration or death) are dropped from the income regressions. Because of missing or zero income, we choose not to use log of income as our main outcome variable. Instead we create two variables capturing whether the individual earns above certain thresholds (low and high). These thresholds are based on the pension base rate [“Grunnpensjon”]. This is a rate adjusted annually and forms the basis for calculating the Norwegian state pensions. The thresholds we look at are incomes 2 and 5 times the pension base rate. In 2017 this corresponds to a bit less than 20 000 and 50 000 euros. Both income and the pension base rate are adjusted for wage inflation. Earning of at least 20 000 euros is an indication on whether the individual participates in the formal labour market, whereas earning at least 50 000 euros is an indication of full-time employment. We make dummies to capture whether an individual earned above or below the pension base rate in the following way: An individual whose earnings in the age-interval 35 to 40, is above the pension base rate for those years, get the value 1 and 0 otherwise.

3.4 Sample selection

As mentioned above, our sample consists of individuals born between 1940 and 1973. When studying nursing and engineering we exclude areas that offered degrees in nursing and engineering prior to 1940 since they were no part of the college establishment taking place in the 1950s- and 60s which had a strong component of regional policy measure. This involves that we mainly drop individuals living in the biggest cities and some nearby areas.²¹ Our total sample consists then of 688 939 individuals. The college degree in business was first offered in 1969 as part of the roll-out of university colleges across the country. Hence, we do not drop any observations when looking at business. The data used in this paper are summarized in Table 1.

In the upper left panel we see that nursing is very female oriented and engineering is very male oriented. Having a degree in business on the other hand (lower left panel) is equally distributed across gender. When stratifying on parental education (middle and right panel) , we see that all

²¹The following cities are dropped both for nursing and engineering: Bergen, Bodø, Follo, Grimstad, Lillestrøm, Oslo, Skien, Stavanger, Trondheim, Tønsberg - total 700 835 observations. This implies that we also drop the neighbouring municipalities, belonging to the pre-defined commuting zones . A map of the areas that are dropped is shown in Appendix A.1.

three degrees are more common among people whose parents have higher education than among individuals of lower educated parents.²² Turning to labour market outcomes, more men than women earn above 20 000 and 50 000 euros, and the fraction crossing these two thresholds are also higher for both men and women with a higher educated mother compared to men and women with a lower educated mother. Note also that a low share of woman earn equivalent to full-time salary. The youngest cohort in our sample was born in 1973.

3.5 Empirical strategy

The decision to take higher education, and which field to specialize in, is not exogenous. For example, choice of field may be correlated with unobserved preferences which also affect future labour market outcomes. We propose to solve this problem by exploiting the time-variation in the roll-out of colleges across the country, and estimate the reduced form effects of college establishment on the probability of taking the specific degree being offered. This reduced form equation can be modelled in the following way:

$$Outcome = \gamma reform_{i,age} + \omega_t + \phi_m + t \times \phi_m + v_i \quad (1)$$

Outcome is an indicator variable equal to 1 if an individual has the given outcome - for example a degree in nursing. The probability of obtaining such a degree depends on whether the individual resides in a municipality offering a college degree in nursing or engineering, or is residing in a municipality with commuting distance to another municipality that offered the same degrees. In the remainder of the paper, we will denote this as “access to college”. Figure 3 gives an overview over municipalities with commuting distance - affected zones - (in dark blue) to a municipality with a higher education institution offering the degrees of interest (in red).

As explained in Section 2.2, in the period we study, there was substantial variation in the age at which individuals started higher education. Instead of defining a particular age as the first treatment

²²An individual is defined to have lower/higher educated parents if the mother has 10 years of schooling or less/more than 10 years of schooling.

Table 1. Summary statistics: Fraction with a degree in nursing, engineering and business and administration and labour market outcomes

	All		Mother low ed		Mother high ed	
	Women	Men	Women	Men	Women	Men
Nursing degree	0.071	0.008	0.051	0.005	0.096	0.012
Engineering degree	0.009	0.062	0.006	0.045	0.014	0.083
Mean earnings age 35-40						
- >20 000 euros	0.75	0.92	0.71	0.92	0.82	0.94
- >50 000 euros	0.24	0.69	0.17	0.65	0.32	0.74
- average	1681.847	2852.227	1449.632	2571.258	1979.139	3228.116
Nr of obs	325275	363664	182422	207922	142853	155742
Business degree	0.020	0.022	0.012	0.013	0.028	0.031
Mean earnings age 35-40						
- >20 000 euros	0.76	0.92	0.71	0.91	0.81	0.93
- >50 000 euros	0.26	0.71	0.18	0.66	0.34	0.75
- average	1731.911	2963.829	1466.942	2621.089	2021.223	3352.784
N	842975	932393	439367	495027	403608	437366

Note: The individuals in this table are born between 1940 and 1973. For nursing and engineering we only include individuals whose municipality of residence at the age of 16 was not within commuting distance of a college before 1940. For business we include all individuals as the business degree was first introduced in 1969. When looking at average income, we drop observations with missing information (zeros are included). This leaves us with a sample of 362 027 men and 324 002 women in the upper panel and 932 393 men and 842 975 women in the lower panel.

age, we estimate several specifications where we define $reform_{i,age}$ to be a dummy variable taking the value one if the individual gets “access to college” at different ages, ranging from 15 to 26. I.e. $reform_{i,18}$ takes value one if an individual was 18 years or younger when he or she got access to college, $reform_{i,19}$ takes value one if an individual was 19 years or younger when he or she got access to college, etc. Thus, the treated population consists of individuals who are younger than a specific age (ranging from 15 to 26) at the time the colleges is established.²³ We compare the treated population to a comparison population consisting of individuals who were older than the particular age when the college was established. ω_t designates a full set of cohort dummies, while ϕ_m refers to municipality fixed effects. The reduced form effect is then derived by comparing the difference in the outcome variable between the treated and untreated population in the affected zones to the difference in the same outcome variable between the treated and untreated population in the unaffected zones. A positive difference implies that college establishments increase the take-up rate for degrees in nursing, engineering and business administration. We also include municipality specific time trends represented by $t \times \phi_m$. This relaxes the assumption, crucial to difference-in-difference estimation, that treated and untreated municipalities experience parallel trends before the college establishments. The common trend assumption may also be violated if the roll-out of the reform across municipalities and regions is systematically correlated with characteristics that also affect our outcome variables. We will come back to this issue in the next subsection. v_i is a random error term, and is clustered at the municipality level. Equation (1) is estimated separately for men and women.

Parents may behave strategically in the sense that they choose to move to a municipality with access to college. In order to shed some light on this potential problem, we perform robustness checks where we measure residential municipality at the age of 10 instead of 16. Moreover, we also show that the results are not sensitive to how we create the affected commuting zones and that the results do not change substantially if we drop individuals residing in zones that where never

²³We only have information on starting time at the individual level for those undertaking degrees after 1974. The only information we have on this for cohorts entering higher education before 1974 are Statistics Norway reports on the age composition of students in nursing schools. The median age according to these records is similar to what we find in our data for those entering nursing after 1974. However, these records do not report the starting age.

affected.

Almost at the same time as the college reform took place, compulsory schooling also expanded in Norway, from 7 to 9 years. This reform began in 1960 and was completed in 1975. The compulsory schooling reform also involved a standardization of the curriculum which possibly enabled more students to become eligible for enrolling in nursing and engineering schools. As a large part of our sample, namely those born between 1946 and 1961, were subject to the roll-out of this reform, we also control for being exposed to this reform. The inclusion of the compulsory schooling reform does not alter our results.

In a next step we also estimate the reduced form effects of being affected by the college reform on labour market outcomes when 35-40 years old. As outcome variables we use dummy variables taking the value one if the individual earns above a certain threshold (low, medium and high) as outlined above. Additionally, we also estimate specifications where we look at the intensive margin, i.e. our outcome variable is log of income involving that individuals with zero and missing values are not considered. The regression model is similar to 1, with the dummy variables for low, medium and high income on the left hand side instead of educational attainment. As the estimated coefficients are reduced form coefficients, this model estimates the effect on labour market participation of being exposed to the college reform. The main reason for not presenting 2SLS estimate is a questionable exclusion restriction; college establishments may have affected wages other than through college degrees. As mentioned in the introduction, geographical expansion of higher education has been shown to affect productivity, skilled wages and innovation (Carneiro et al., 2018; Andersson et al., 2009)

3.6 Timing of college establishments not correlated with observed municipality characteristics

If our reduced form estimates are to be interpreted in a causal fashion, we must assume that the timing of college establishments are unrelated to underlying trends at the municipality level. Unfortunately panel data at the municipality level is scarce. However, both the 1950 and 1960 census provide aggregate level municipality characteristics. The characteristics we look at are education

level, voting behavior and sectoral composition of the local labor market. We follow the empirical strategy in Bhuller et al. (2017) to investigate whether the timing of reform implementation is correlated with municipality characteristics as recorded in the censuses. In other words we want to check whether, given municipality characteristics in 1950 or 1960, we could have predicted in which areas the new colleges were to be established.

We run the following regression

$$T_{mt} = (T_t \times B_{m,1950})' \gamma_t + \varepsilon_m \quad (2)$$

where T_{mt} is equal to 1 if municipality m implemented reform in year t and $B_{m,1950}$ is a vector of municipality level information from the 1950 and 1960 census. In this way γ_t captures whether there is a correlation between the year of college establishment and municipality characteristics, in addition to the difference between municipalities near the new colleges and municipalities that did not get college access throughout the period. The chosen municipality characteristics are based on Bhuller et al. (2017), but for the 1950 census only some of these characteristics are available.

Plots of the coefficients are shown in Appendix B. The coefficient plots show the estimates for γ_t from the regressions with each municipality level characteristic. If γ_t is zero there is no correlation between year of college establishment and municipality census characteristic. There seem to be no systematic negative or positive trend for these coefficients. It would be problematic if for example there seemed to be the case that municipalities where colleges were established early, had a higher education level than those where they were established later or have a different share of the population working in industry or the service sector. In general there seems to be no systematic differences in municipality characteristics between municipalities that were the first to get college access after 1940 and those that got access later.

4 Results

We now turn to the estimation results obtained by using the empirical approach presented in the previous section. We proceed in four steps. First, we assess the overall effect of the education reform on the choice of field for the affected individuals. Second, we examine whether there is heterogeneity with respect to parental background. Third, we address labor market outcomes, measured as income between 35 and 40 years. Finally, we also examine the broader picture of counterfactual outcomes, e.g. what the education choices of the affected individuals had been had the reform not been implemented.

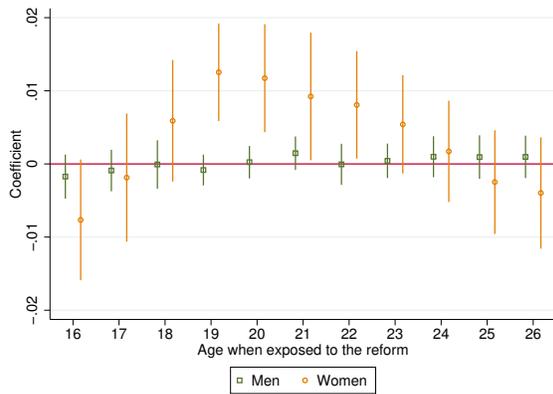
4.1 *College proximity and choice of field*

The reduced form estimates from estimating Equation (1) for men and women separately are presented in Figure 4. Panel (a) shows the coefficient when the outcome is whether an individual obtains a nursing education; panel (b) has engineering education as outcome and panel (c) business administration. In each panel, coefficients from 24 separate regressions (12 for women and 12 for men) are plotted. In each regression, for a given age i , we define “access to college” as being i years or younger at the time a college was established within commuting distance (denoted “affected zone” below). In each regression, municipality and cohort fixed effects are included, in addition to an interaction between these two (municipality-specific time trends) and a control variable indicating the compulsory schooling reform.

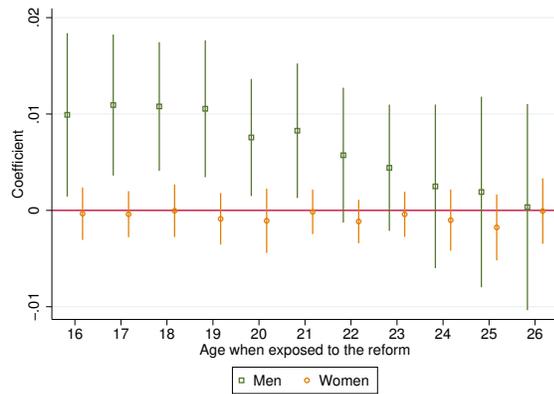
For nursing, the effect is positive and statistically significant for women who were between 19 and 22 (and younger) when the college was established. For instance, women in affected zones who were 19 year or younger when the college was established had a higher probability of taking a nursing degree (compared to older women in the same zones) than women the same age living in unaffected zones. A point estimate of 0.013 indicates that the share with nursing education increases by 1.3 percentage points (or equivalently, the probability of obtaining a nursing degree increases by 1.3 percentage points) compared to unaffected zones. For men the effect of getting access to a nursing college is close to zero.

Figure 4. The reduced form coefficients of the college reform on the probability of taking a degree in nursing and engineering

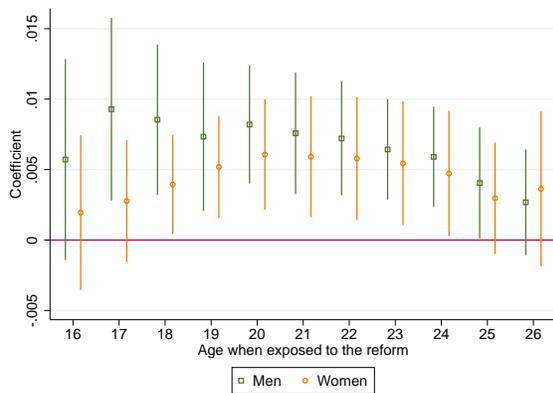
(a) Nursing



(b) Engineering



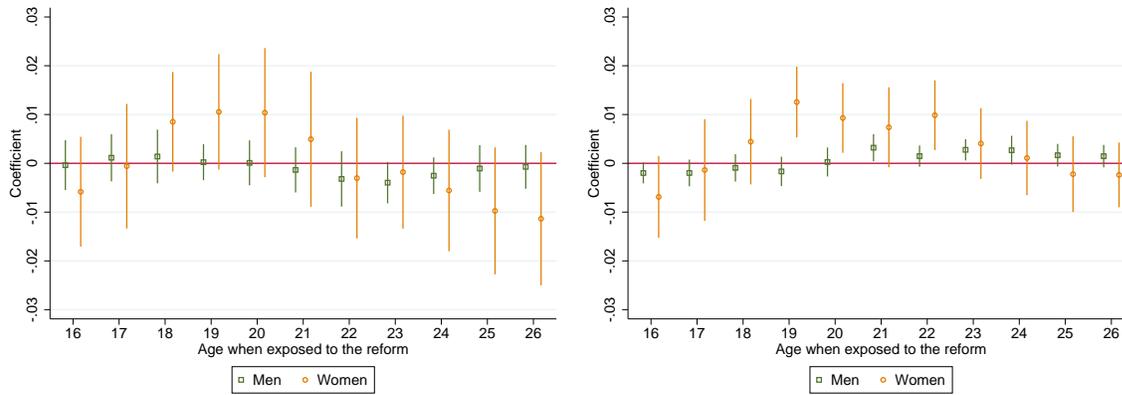
(c) Business



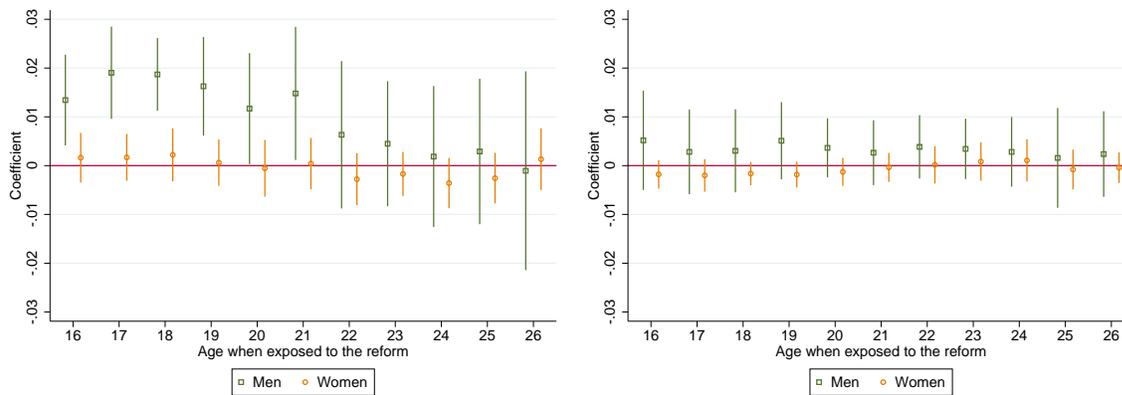
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

Figure 5. The reduced form effects of the college reform on the probability of taking a degree in nursing and engineering, estimated separately for higher (left)- and lower (right) educated mothers

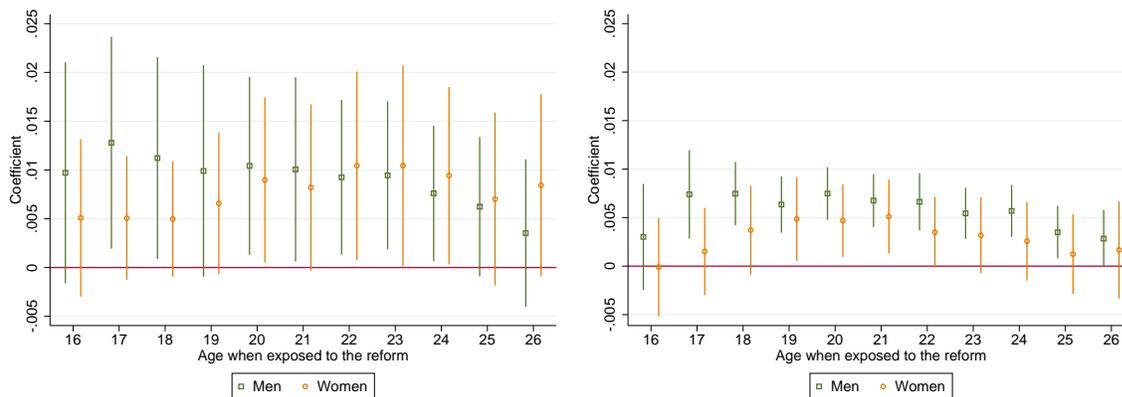
(a) Nursing



(b) Engineering



(c) Business



Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

Looking at engineering, there is a positive and significant effect for men who were between 15 and 21 (and younger) when the engineering college was established. The point estimate is about 0.01 indicating a 1 percent increase in the share with a engineering degree (from a sample mean of 6 percent). The effect for women is zero.

Turning to business, men and women living in zones where a business college is established have the same probability of taking a degree in business. The point estimates for men are slightly higher than for women, especially for the youngest ages, but they are not significantly different.

Summarized, we find substantial effects of the establishment of colleges on choice of field, in the sense that individuals in affected areas have an increased propensity to take up the educations on offer. However, there are some important exceptions: men do not respond to extension of nursing degrees and women do not respond to engineering degrees. In this way, existing gender patterns are preserved.²⁴

4.2 Heterogeneity with respect to parental background

In Figure 4 we report results from estimating Equation (1) when stratifying on mother's education (which is a variable reported at the individual level in the educational database). The results for nursing are presented in the upper panel, the results for engineering are presented in the middle panel and the results for business are presented in the lower panel. For nursing and engineering the point estimates are of the same magnitude across socio-economic background, although a bit more precise for those with a lower educated mother . For engineering, the results are clearly higher and the estimates more precise for men with a higher educated mother. All the results presented in both Figure 4 and 5 are also reported in Appendix Table C. In the sample period we focus on, mothers had lower education than the fathers. If stratifying on fathers' length of schooling instead, the results are unaltered. We find no effect of the compulsory elementary schooling reform. These results are not reported for brevity, but are available upon request.

²⁴ Although we only report the point estimate for access to nursing (engineering/business) college in the specifications where nursing (engineering/business) degree is the outcome variable, we also control for access to engineering/business (nursing) colleges. This does not affect the the main results.

4.3 *Labor market outcomes*

We now turn to a further examination of how the college openings affected the labour market outcomes of the affected individuals when they are between 35 and 40 years old. As our income data is obtained from the public tax and pension system, we do not have direct information on working hours and hourly wage. Rather, we interpret the income data on two different margins. First, by examining the share of individuals above a certain income thresholds, we can assess the effect of the college reform on participation in the formal labor force. In particular we focus on two thresholds, minimum income (23.230 USD)²⁵ as an indication to what extent the individual participates in the formal labour force, and equivalent full-time salary (58.114 USD)²⁶ as an indication to what extent the individual works full time. Second, by using log income as outcome in a regression contingent on being part of the labor force, we get an impression of the intensive margin.

For both nursing and business, but also to a large extent engineering, the effects on the take up rate seems to be largest for individuals who are between 18 and 22 when treated for the first time (where 19 means 19 years or younger when the college is established, 20 is 20 years or younger when the college is established, etc.). In this analysis we therefore only focus in this age interval.

We estimate Equation (1), but change the outcome variable to the different labour market outcomes described above. The results are reported in Figure 6. In the upper panel we report the reduced from effects for women exposed to new nursing colleges and men exposed to new engineering colleges, whereas we in the lower panel report results for men and women exposed to new business colleges.

For nursing and engineering there are no effects of college openings on neither participation in the formal labour force, working full time nor the intensive margin. For business on the other hand, men who get access to a college degree in business seem to perform better in the labour market than men living in regions that did not get access to the same type of education. This is especially true for participation in the formal labour market, but also for the intensive margin. For women the

²⁵This figure equals two times the pension rate mentioned in subsection 3.3.

²⁶This figure equals five times the pension rate mentioned in subsection 3.3.

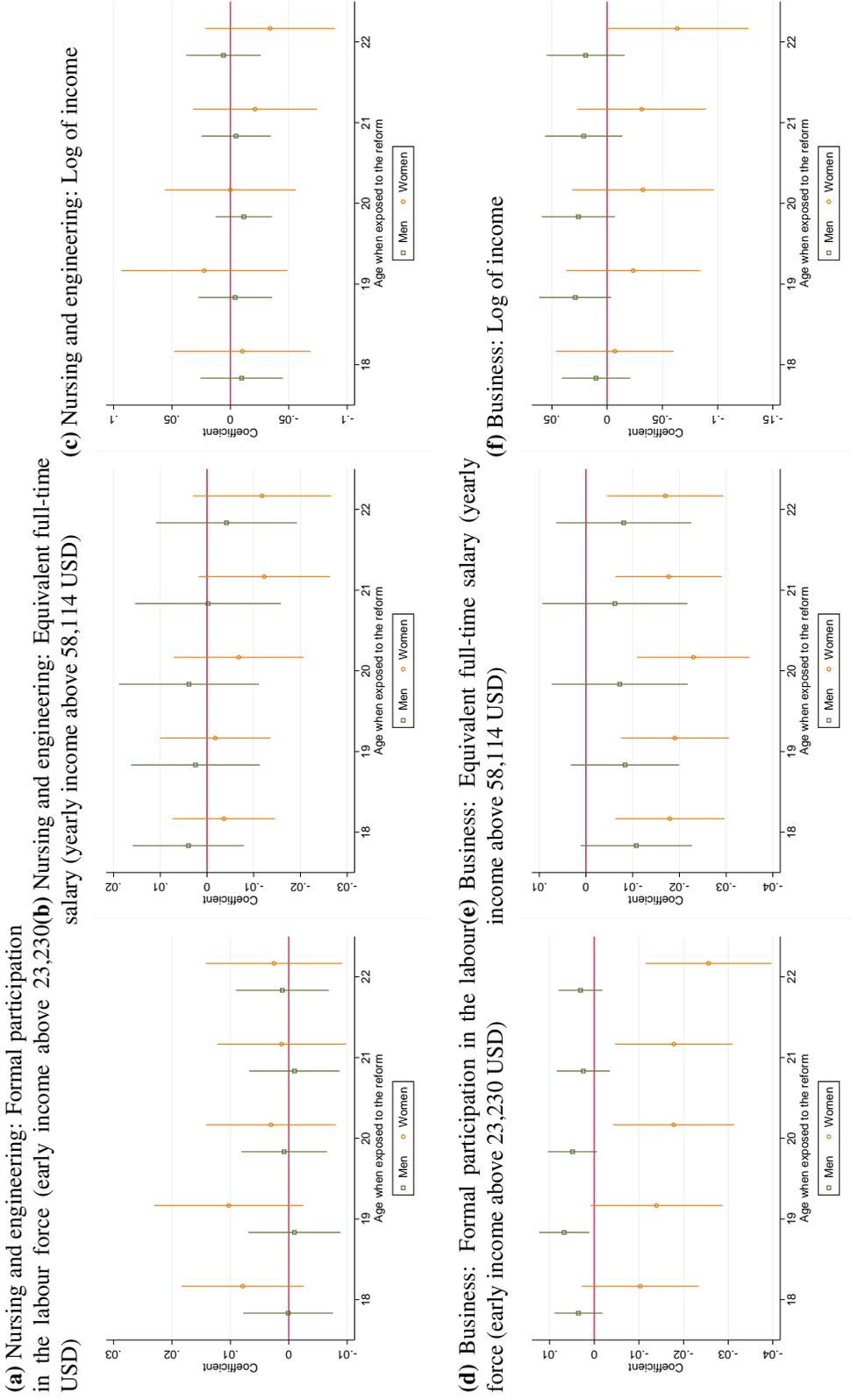
effect on crossing income thresholds are negative and significant. The labour market behaviour of getting access to nursing and engineering schools does not vary across socio economic background. This is documented in Appendix Table C.4 and C.5 where we stratify on mothers education. The negative effect of the openings of business and administration colleges on women's labour market outcomes is to a large extent driven by those with a lower educated mother. Hence, even though men and women have the same take-up rate for a college degree in business, the labour market outcomes differ across gender. One reason for this could be that, conditional on the same degree, men end up with occupations with higher earnings in the labour market. Unfortunately, there is limited occupation data for the period we study, as high-quality annual occupation data is not available until 2008.²⁷

However, when looking at the available data on occupation we find that, contingent on having a degree in business (10,788 individuals between), the most common occupations are administrative and mercantile leaders (occupations classified as management positions), ICT advisors (classified as academic professions), various occupations within the culture and sport sector (classified as college careers) and general office workers. When looking at how this varies across gender we see that among those who work as administrative and mercantile leaders, 67 percent are men. As a comparison, 74 percent of the general office workers are women. For ICT advisors and professions in the culture and sport sector, the division across gender is roughly fifty-fifty. A complementary description if this is reported in Appendix Table C4.

We also check whether being affected by college openings in nursing, engineering and business affect the probability of moving. In Appendix Table C.6 and C.7 we present results from regressing Equation (1) when changing outcome variable to a dummy variable taking the value one if the individual still lives in the same municipality (panel a) or region (panel b) as the college at the age of 35. As above, when looking at nursing colleges, we only focus on women. And likewise, when looking at engineering colleges, we only focus on men. For business and administration, we focus on both men and women. In the left panel we present results for nursing and engineering.

²⁷Occupation data for some sectors of the economy (with highest quality for the private sector) are available annually from 2003, and there are full-count censuses every decade until 1980 (and a smaller sample for 1990).

Figure 6. The reduced form coefficients of the college reform on labour market outcomes



Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

For nursing and engineering the point estimates are in most cases very imprecise. For business and administration on the other hand, both men and women who are treated seem to have a lower probability of moving out of the region compared to men and women in the control group.

In order to better understand the results in this section, we now turn to investigate the counterfactual outcomes: What would the treated individuals have done in the absence of the establishment of colleges in nursing, engineering and business and administration? .

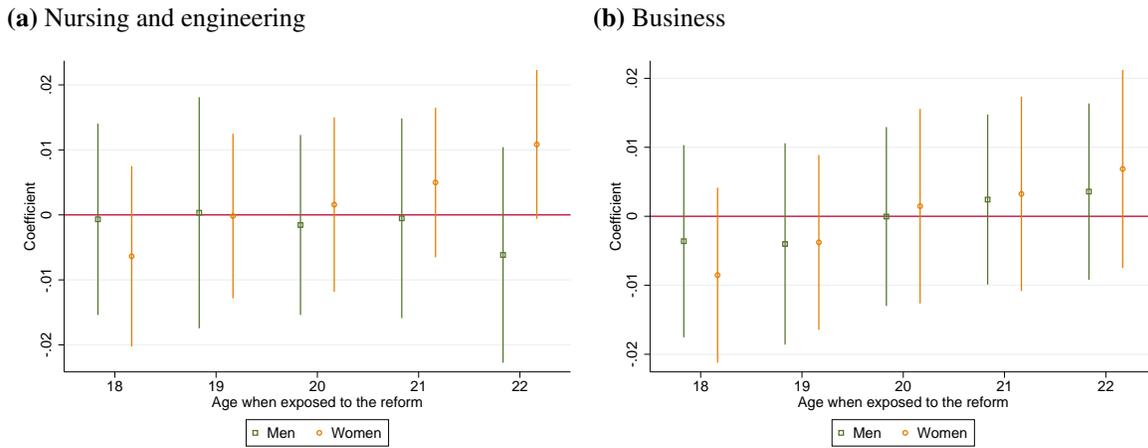
4.4 Counterfactual outcomes

In our setting, the reform is associated with changes in the costs of undertaking nursing, engineering and business administration degrees. If we were to fully understand the effect of the reform for those who were induced to undertake these degrees due to a reduction in costs, we would need information on their next-best alternatives (Kirkeboen et al., 2016). Given that there is no information on this in the historical registries, we have to infer the counterfactual outcomes indirectly by investigating how the reform affected other outcomes than the degrees subject to the geographical expansion. Looking at this, we get an indication of what the treated individuals would have done in the absence of the reform. In order to interpret the following results as counterfactual outcomes, we must assume that the reform only affected the uptake of other degrees (i.e. those not part of the reform) by lowering the cost of the degrees that were now available within commuting distance from the treated individual's home municipality.

As a first step, we look at whether the reform affected the probability of taking higher education. Those results are reported in Figure 7. For women we only report the reduced form coefficient from the establishment of nursing colleges, whereas we for men only report the reduced form coefficient from the establishment of engineering colleges. For both men and women we see that the opening of new nursing- ,engineering colleges as well as regional colleges did not affect the probability of taking higher education. This finding implies that the reform may have altered the field, rather than the level of education.

We pursue this further by looking at how the choice of other educations changed in response to

Figure 7. The reduced form effects of the college reform on taking 2 or more years of higher education



Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term.

the respective reforms. For each individual, we observe all education spells, and as one individual may obtain several educations, we define a list of priorities where the highest ‘ranked’ education on the list will be the one assigned to an individual. The exact ranking order does not matter much for the outcomes, with the exception that we rank longer educations (masters degrees) higher than educations with shorter duration; for example, very few individuals in our data obtained degrees in both technical and health related fields.²⁸

The Norwegian education data base (NUDB) uses the following categories of fields: Teaching, technology, administration, health, social science and humanities.²⁹ In these registries technology includes STEM subjects, administration includes business, accountancy and management, while social sciences consists of degrees such as law, political science and sociology. Other degrees

²⁸The variable ‘field’ is constructed by taking the education with the highest number in this list: 10: Any master or Ph.D. degree; 9: Health; 8: Technical fields 7: Teaching; 6: Administration; 5: Social Science /Humanities; 4: Vocational School (“Fagskole”); 3: High school year 3; 2: High school year 1 and 2; and 1: Mandatory schooling. Thus, a person with a degree in teaching at college level, that later pursued a master degree will have a level 10. A person with a teaching and a business/admin degree will end up with a 7 as teaching is ranked higher.

²⁹As the number of students in humanities is very small, this category is merged with social sciences in our analysis. There are two more categories, primary industries (such studies in farming and fishing) and transport and security (for example police and drivers). These are not used as outcomes because the number of students with degrees in these fields at college level is very small.

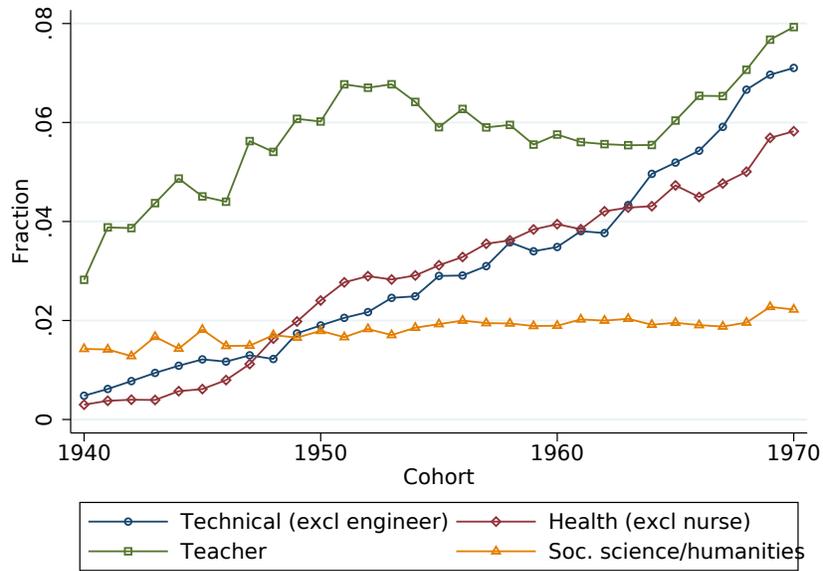


Figure 8. The fraction with a degree teaching, health (excl. nursing), technical subjects (excl. engineering), social science and humanities.

in health, at the same level as nursing, are for example social worker, physiotherapy and dental hygienists. The level is determined by both the institution offering the degree and its length. Thus, the degrees at the same level as nursing, business administration and engineering will be 2-3 year degrees.

As documented in Figure 8, the proportion who took a degree in one of the educational directions we focus on increased steadily from about 1 per cent among the 1940 cohort to about 5 - 8 percent among the 1970 cohort. The development in the teaching profession differs a bit from the rest. About 3 percent of the 1940 cohort has a degree in teaching (which is higher than for the other fields). The proportion with a teacher education increases to almost 7 percent for the 1950 cohort, then declines to 5.5 percent for the 1960 cohort. It then increases again, and is as high as 8 percent for the 1970 cohort.

The results from estimating Eq 1 when changing outcome variables to obtained degrees in other fields are reported in Figure 9 (nursing and engineering) and 10 (business and administration). In all specifications we include the same control variables as in Figures 4 and 5.

The only field which is negatively affected by the opening of new nursing colleges, is teaching

which suggest that women living in regions with newly opened nursing colleges would have become teachers in the absence of access to a nursing college. As already illustrated in Figure 8, the fraction taking a teacher degree declined from 7 to 5.5 percent from the 1950 to the 1960 cohort. For the same cohorts, the fraction taking a nursing degree increased from 1.2 percent to 4.7 percent (see Figure 1). There is also some evidence that technological educations (excluding engineering) are suppressed by engineering colleges, although those point estimates are not as large as for teachers. For men, the point estimates for business and administration is also negative, but not very precisely estimated. Turning to the counterfactual outcomes for business, we see that the opening of the new business schools negatively affected the take up rate of engineering degrees among men. For women, there are some indications that women may have chosen a degree in teaching or social science and humanities in absence of a local business college.

Summarized, the results in this section indicate that the college reform did not affect the level of education, but altered the choice of field, but not in such a way that it changed the gender segregation to fields.

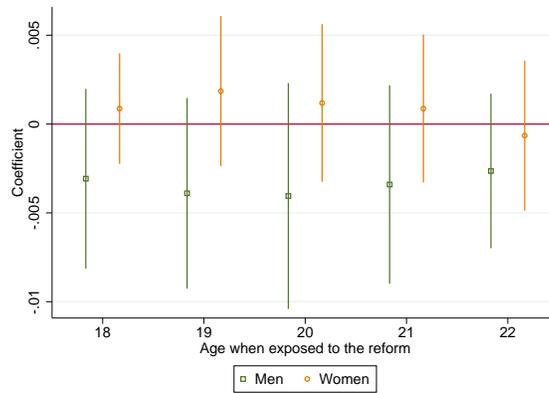
4.5 Robustness checks

In this subsection we investigate to what extent the point estimates of college access are sensitive to the way we have chosen to define college access. Our measure of college access may be biased if commuting is correlated with factors that affect the outcome through other channels than proximity to college. We therefore create alternative measures of affected zones. As first and second robustness measures we define individuals to get access to college if they live within a radius of 30 and 50 kilometres from the centre of the municipality where the college was established.³⁰ Third, we check whether our results are robust to using Classification of economic regions, which are based on recent commuting data (Statistics Norway, 2000). As can be seen in Figure 11, this does not seem to affect the results.

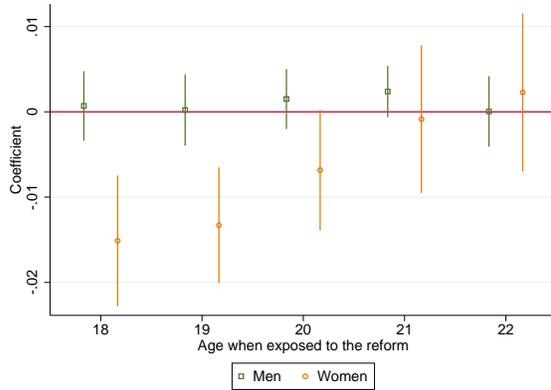
Second, to address that parents may move to a municipality with a college before the age of

³⁰The distance is measured using the coordinates of the administrative centre of a municipality

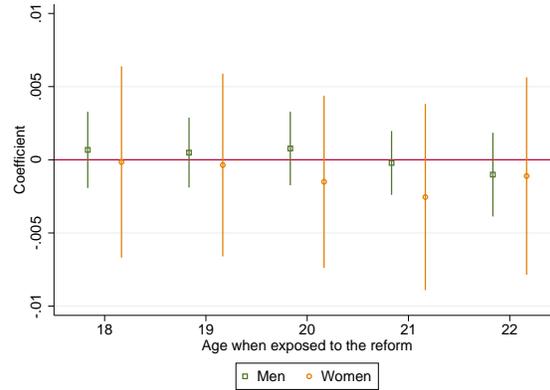
Figure 9. The reduced form coefficients of the college reform (nursing and engineering) on the probability of taking degree in other fields



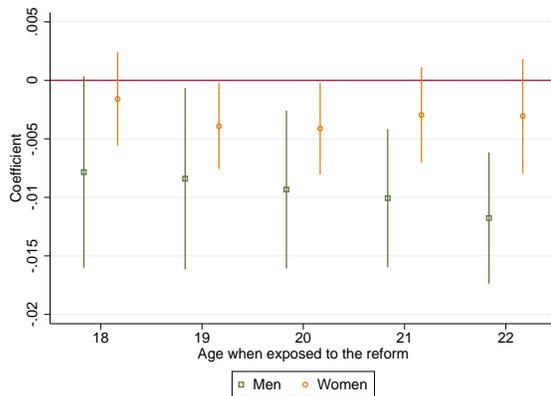
(a) Business



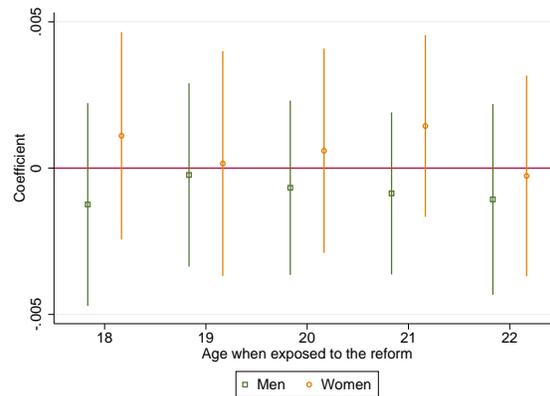
(b) Teaching



(c) Health education (excluding nurse)



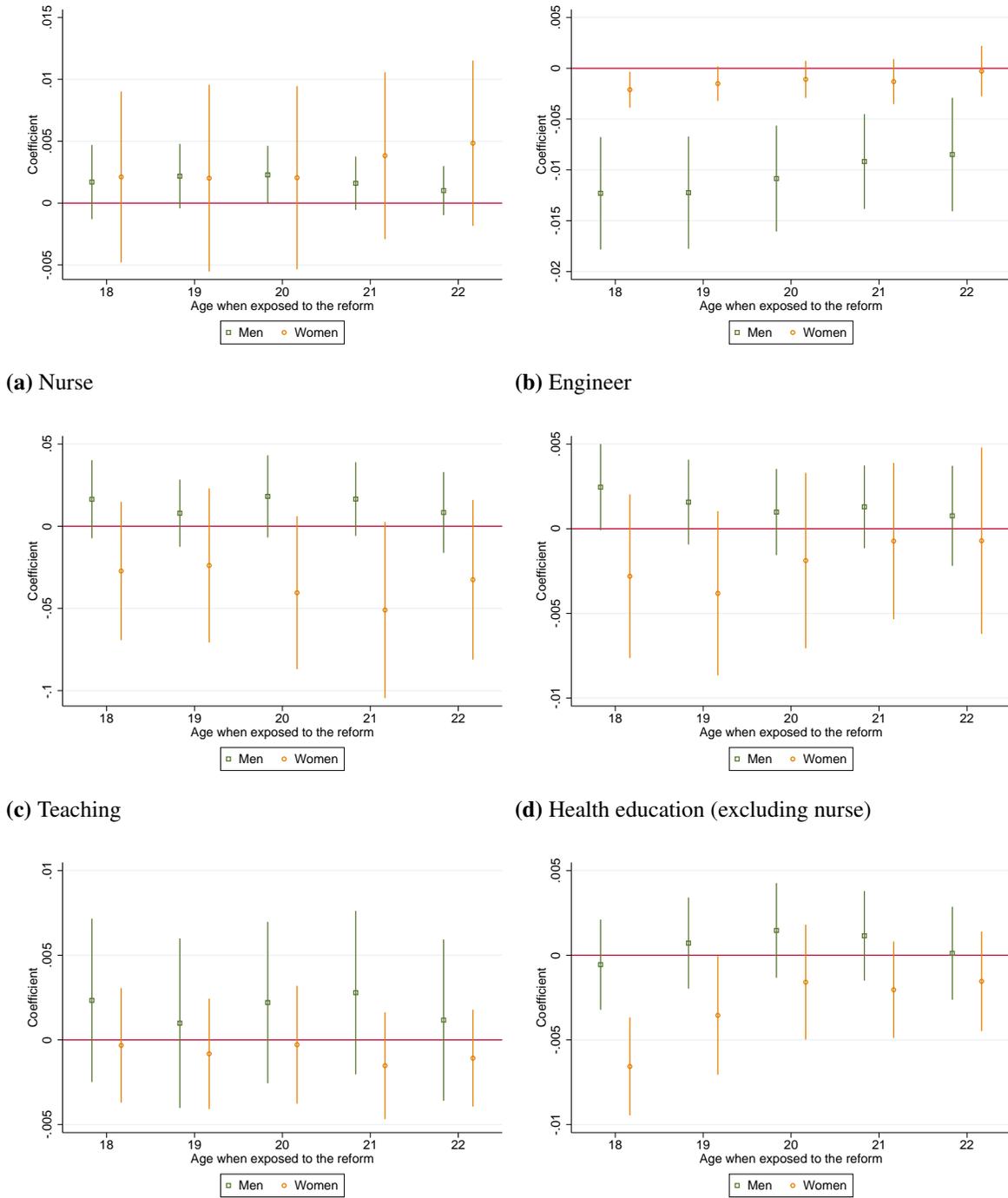
(d) Tech education (excluding engineers)



(e) Social science and humanity

Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

Figure 10. The reduced form coefficients of the college reform (business) on the probability of taking degree in other fields



(a) Nurse

(b) Engineer

(c) Teaching

(d) Health education (excluding nurse)

(e) Tech education (excluding engineers)

(f) Social science and humanity

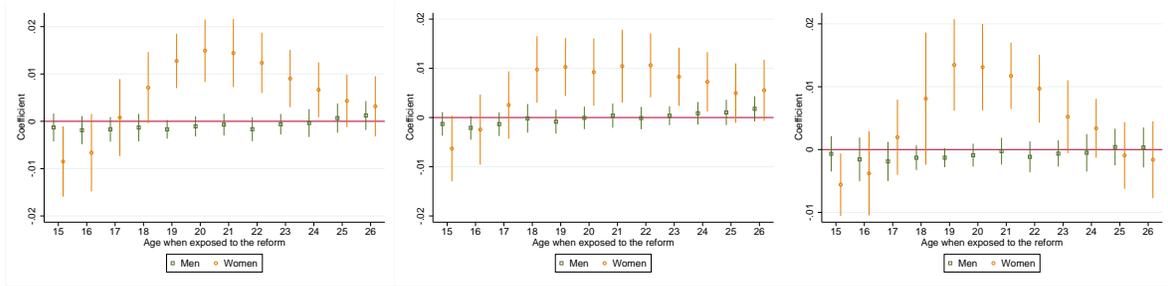
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

16 we estimate the baseline equation measuring residential municipality when an individual is 10 instead of 16.³¹ Finally, we also check how our estimates change if we only include individuals residing in the commuting zones where the new colleges were established. The reason for doing the latter is that we are afraid that affected and unaffected zones develop differently in ways that are not captured in the municipality specific time trends. The results are presented in Figure 12, and shows that the results are qualitatively similar to those in Figure 4 .

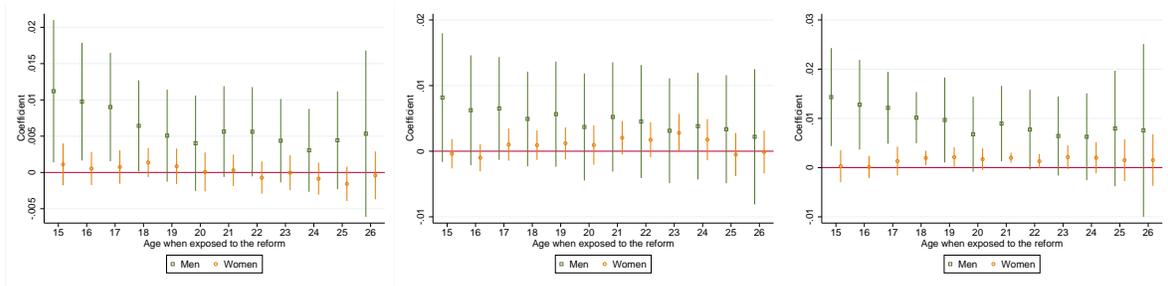
³¹The reason why we choose 16 instead of 10 as the baseline is that the first time we observe municipality of residence is in the 1960 census, and we can therefore only use cohorts born after 1950.

Figure 11. Robustness checks: The reduced form coefficients of the college reform on the probability of taking a degree in nursing and engineering, estimated for alternative definitions of affected zones. 30 km (left), 50 km (middle) and labour market regions (right)

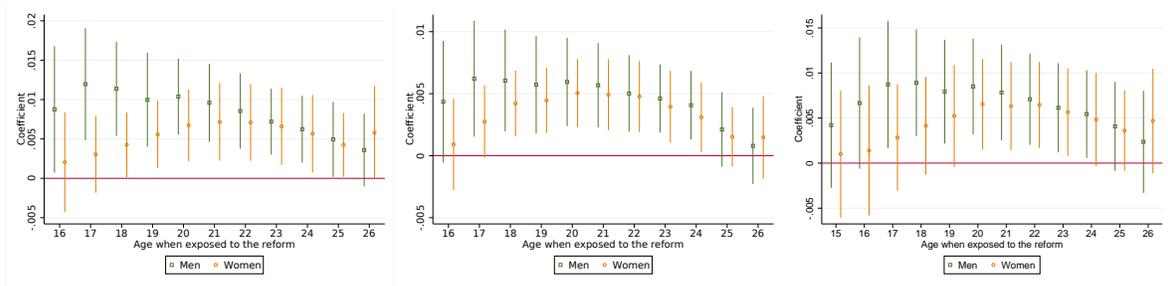
(a) Nurses



(b) Engineer



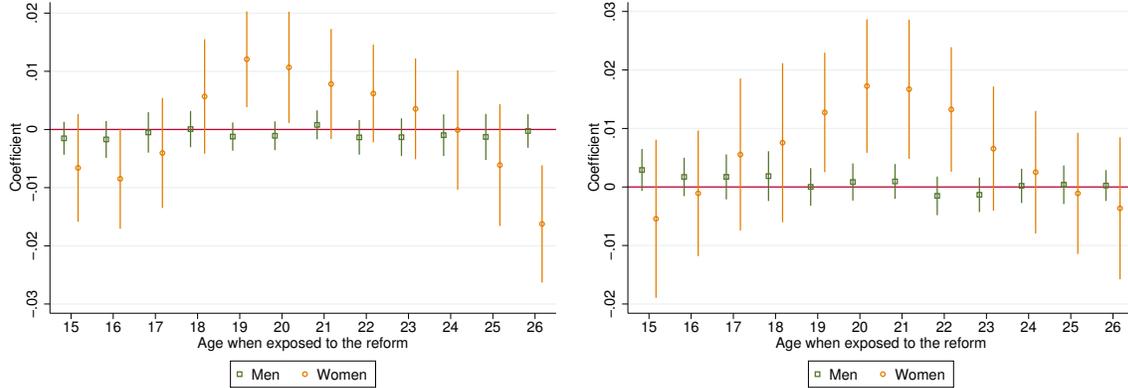
(c) Business and administration



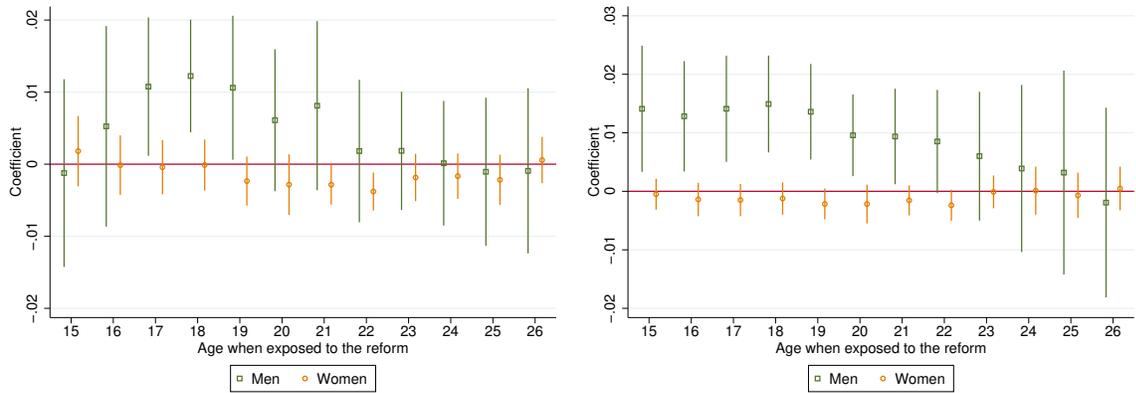
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in specifications in panel a and b are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Included in all specifications in panel c are region fixed effects, dummy variables for birth year, compulsory schooling reform, and region specific time trends (where we interact regions with birth year) and a constant term. Standard errors are clustered at the municipality level.

Figure 12. Robustness checks: The reduced form coefficients of the college reform on the probability of taking a degree in nursing and engineering. Municipality at age 10 (left) and only affected zones (right)

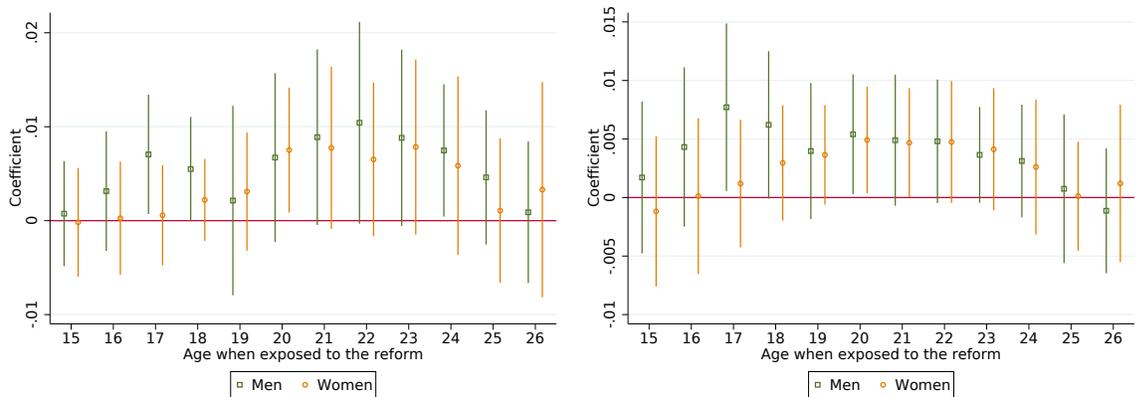
(a) Nurses



(b) Engineer



(c) Business and administration



Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

5 Concluding comments

This paper has shown that the response to the 1960-1980 roll-out of higher education institutions in semi-rural Norway substantially impacted the choice of field for affected cohorts. This is found in a regression setup comparing individuals in the affected areas with older cohorts in the same locations, controlling for region-specific trends. Moreover, we interpret the failure to observe any discernible take-up of engineering for women and nursing for men as an additional indication that underlying trends or reverse causality does not drive the observed results. Although we find large increases in take-up of the college degrees offered at the new colleges, our results suggest that the education level for those whose distance to a higher education institution decreased, did not change. Rather, we find decreases in the propensity to undertake college degrees not offered at the local colleges. Furthermore, there are no effects on incomes neither for men exposed to engineering colleges nor women exposed to nursing colleges. While engineering and nursing both led to clearly defined career paths, a degree in business administration did not. For business degree holders men dominate the manager positions, while women dominate general office positions. We see this in our analysis as women with access to a college offering a degree in business administration, have lower earnings later in life than other women. The results emphasize the importance of examining field of study - and not only level of education - when major changes to the education structure are considered.

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Appendix

Description of the college reform

The information on the location, timing and development of the expansion of colleges in Norway builds on documents from the Parliament: Both white papers and discussions in the parliament which are all digitalized and available from the Parliament's website¹. The regional college system that the central government wanted to achieve is described in a white paper to the parliament signed by the Ottoesen committee (1969) . The central government wanted to meet the demand for higher education in areas without universities as there was a prevailing political opinion that the centralization of economic activity in Oslo had gone too far. The committee wanted to create a college system where the institutions were to be grouped under regional college boards. The parliament emphasized that college expansion were to be seen as a regional policy measure, and did not intend to have large study centres, but rather create many small institutions. An in-depth analysis of the political process leading to the establishments of regional colleges is found in Johnsen (2009). The year of college establishments is gathered from Norwegian Center for Research Data (NSD) and Norwegian Research Council's publication on higher education institutions from 1979 (NAVF, 1979).

¹www.stortinget.no

A Year of establishment and municipality

Table A.1. Establishment year and municipality

Nursing		Engineering		Regional college	
Year	Municipality	Year	Municipality	Year	Municipality
1869	Oslo*	1855	Tønsberg	1969	Stavanger
1895	Lillestrøm	1873	Oslo	1969	Kristiansand
1906	Trondheim*	1875	Bergen	1969	Grimstad
1908	Bergen*, Skien/Porsgrunn	1878	Stavanger	1970	Molde
1918	Tønsberg	1884	Skien/Porsgrunn	1970	Volda
1920	Bodø, Grimstad, Stavanger	1897	Follo	1970	Lillehammer
1927	Elverum	1900	Trondheim	1970	Bø i Telemark
1939	Namsos	1955	Hønefoss, Narvik	1975	Sogndal
1940	Levanger, Tromsø	1965	Fredrikstad, Ålesund	1977	Alta
1955	Fredrikstad	1966	Gjøvik	1977	Halden
1958	Molde	1967	Grimstad	1979	Rena
1960	Hammerfest	1970	Kongsberg	1980	Steinkjer
1970	Gjøvik	1981	Tromsø	1985	Harstad
1974	Ålesund	1988	Førde, Haugesund		
1976	Kristiansand	1989	Levanger		
1977	Stord				
1979	Førde				
1980	Haugesund				
1982	Harstad				

*In the case of Oslo, Bergen and Trondheim year refers to the year of establishment of the first nursing college as several nursing colleges were established in these cities.

A.1 Areas with college access before 1940

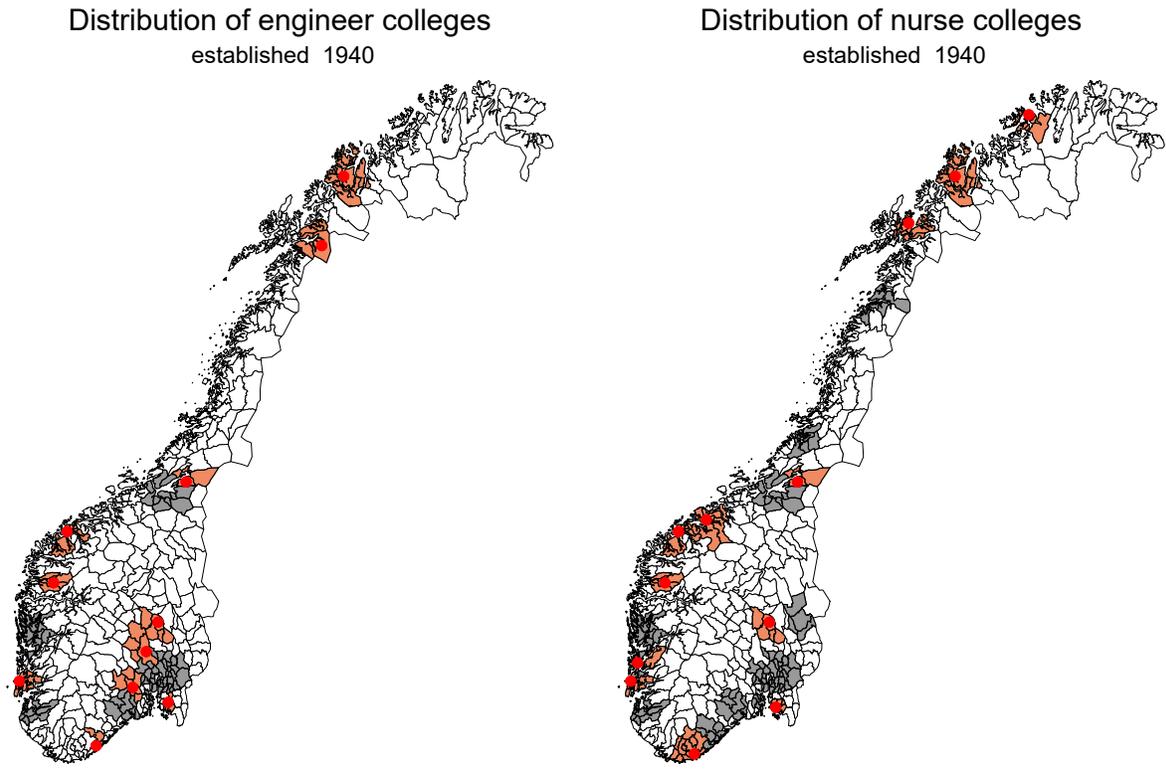


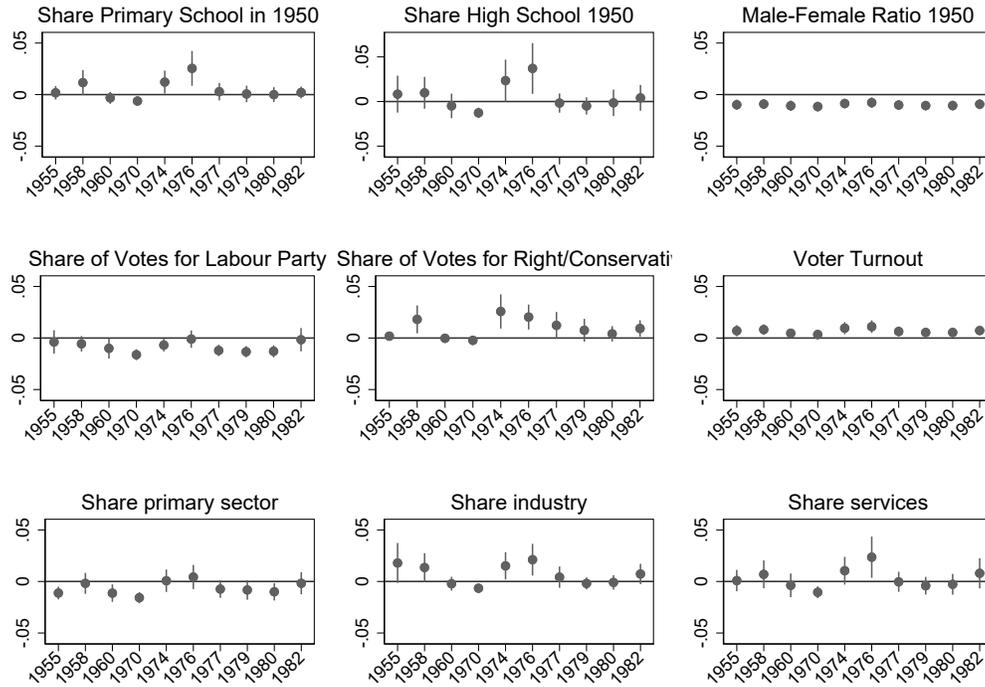
Figure A.1. Maps showing commuting zones for colleges established before and after 1940

Notes: The maps show the commuting zones that got new colleges after 1940 in orange, whereas the red dots indicate the exact college location. The grey areas are the zones with college access before 1940.

B Year of establishment and municipality characteristics

Figure B.2. Timing of reform and municipality baseline characteristics in 1950

(a) Nursing colleges: Plot of coefficient from eq2



(b) Engineering colleges: Plot of coefficient from eq2

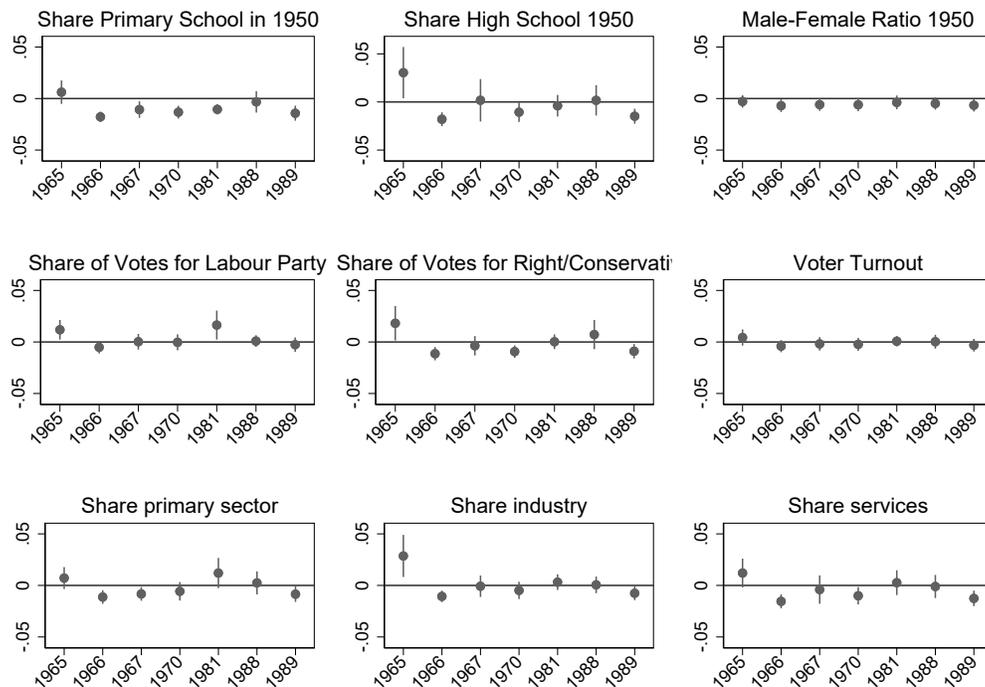
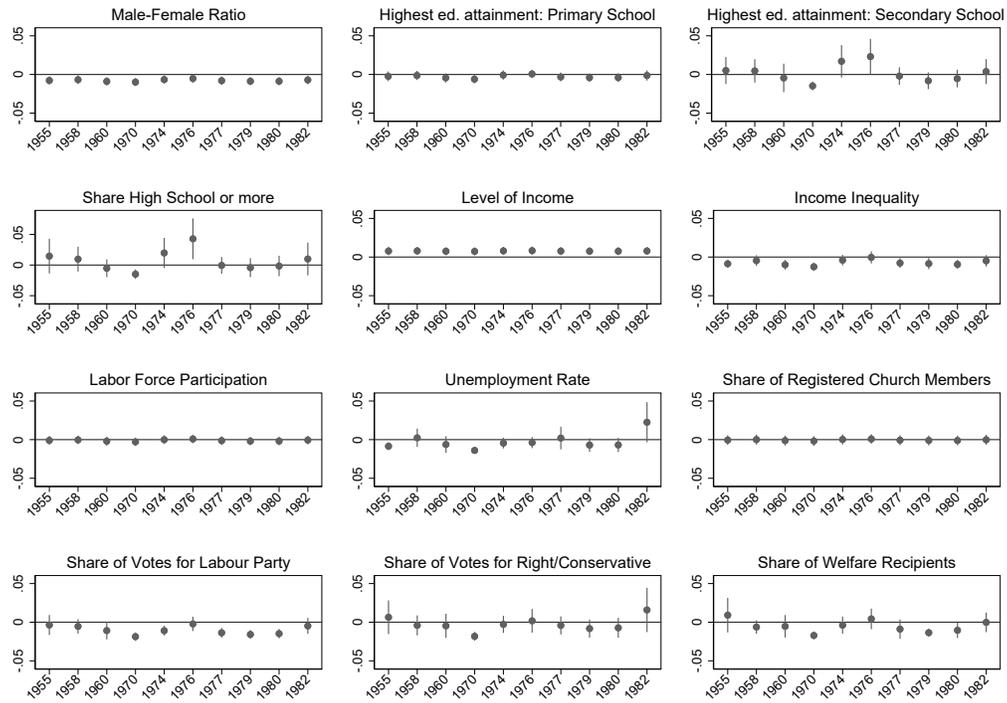
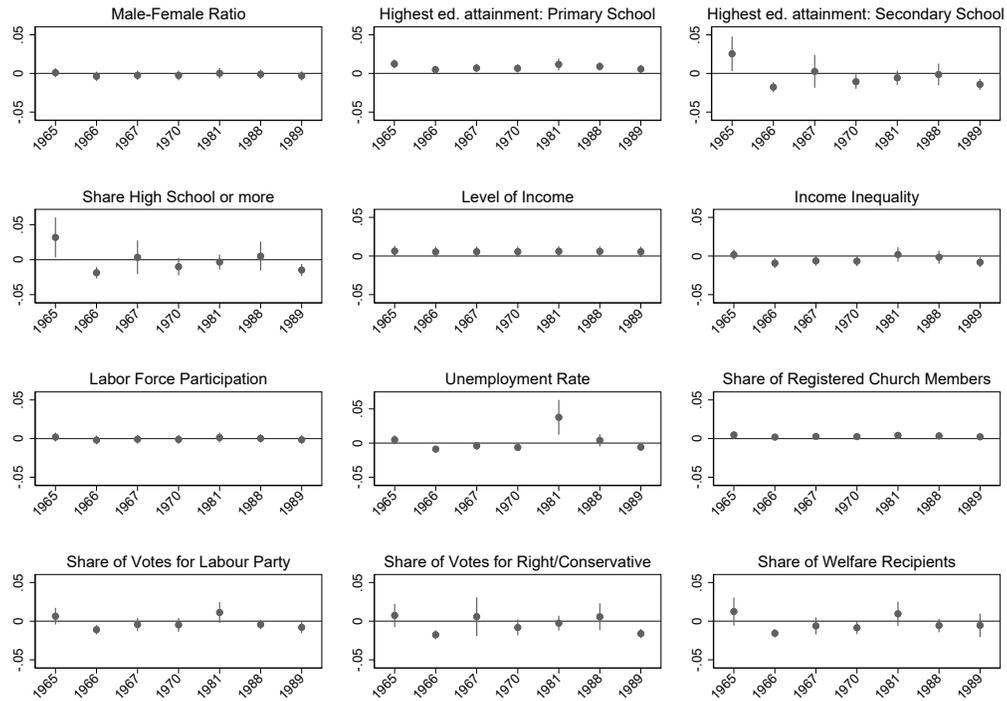


Figure B.3. Timing of reform and municipality baseline characteristics in 1960



(a) Nursing colleges: Plot of coefficient from eq2



(b) Engineering colleges: Plot of coefficient from eq2

C Results: degree attainment and labour market outcomes

Table C.2. Baseline results for nursing

Age when reform implemented	All		M low ed		M high ed	
	Wom (1)	Men (2)	Wom (3)	Men (4)	Wom (5)	Men (6)
<=15	-0.006* (0.004)	-0.000 (0.001)	-0.007 (0.005)	-0.001 (0.001)	-0.004 (0.006)	0.001 (0.003)
<=16	-0.008* (0.004)	-0.002 (0.002)	-0.007 (0.004)	-0.002* (0.001)	-0.006 (0.006)	-0.000 (0.003)
<=17	-0.002 (0.004)	-0.001 (0.001)	-0.001 (0.005)	-0.002 (0.001)	-0.001 (0.006)	0.001 (0.002)
<=18	0.006 (0.004)	-0.000 (0.002)	0.004 (0.004)	-0.001 (0.001)	0.009 (0.005)	0.001 (0.003)
<=19	0.013*** (0.003)	-0.001 (0.001)	0.013*** (0.004)	-0.002 (0.002)	0.011* (0.006)	0.000 (0.002)
<=20	0.012*** (0.004)	0.000 (0.001)	0.009** (0.004)	0.000 (0.002)	0.010 (0.007)	0.000 (0.002)
<=21	0.009** (0.004)	0.001 (0.001)	0.007* (0.004)	0.003** (0.001)	0.005 (0.007)	-0.001 (0.002)
<=22	0.008** (0.004)	-0.000 (0.001)	0.010*** (0.004)	0.001 (0.001)	-0.003 (0.006)	-0.003 (0.003)
<=23	0.005 (0.003)	0.000 (0.001)	0.004 (0.004)	0.003** (0.001)	-0.002 (0.006)	-0.004* (0.002)
<=24	0.002 (0.003)	0.001 (0.001)	0.001 (0.004)	0.003* (0.001)	-0.006 (0.006)	-0.003 (0.002)
<=25	-0.002 (0.004)	0.001 (0.002)	-0.002 (0.004)	0.002 (0.001)	-0.010 (0.007)	-0.001 (0.002)
<=26	-0.004 (0.004)	0.001 (0.001)	-0.002 (0.003)	0.001 (0.001)	-0.011 (0.007)	-0.001 (0.002)
N	325275	363664	182422	207922	142853	155742

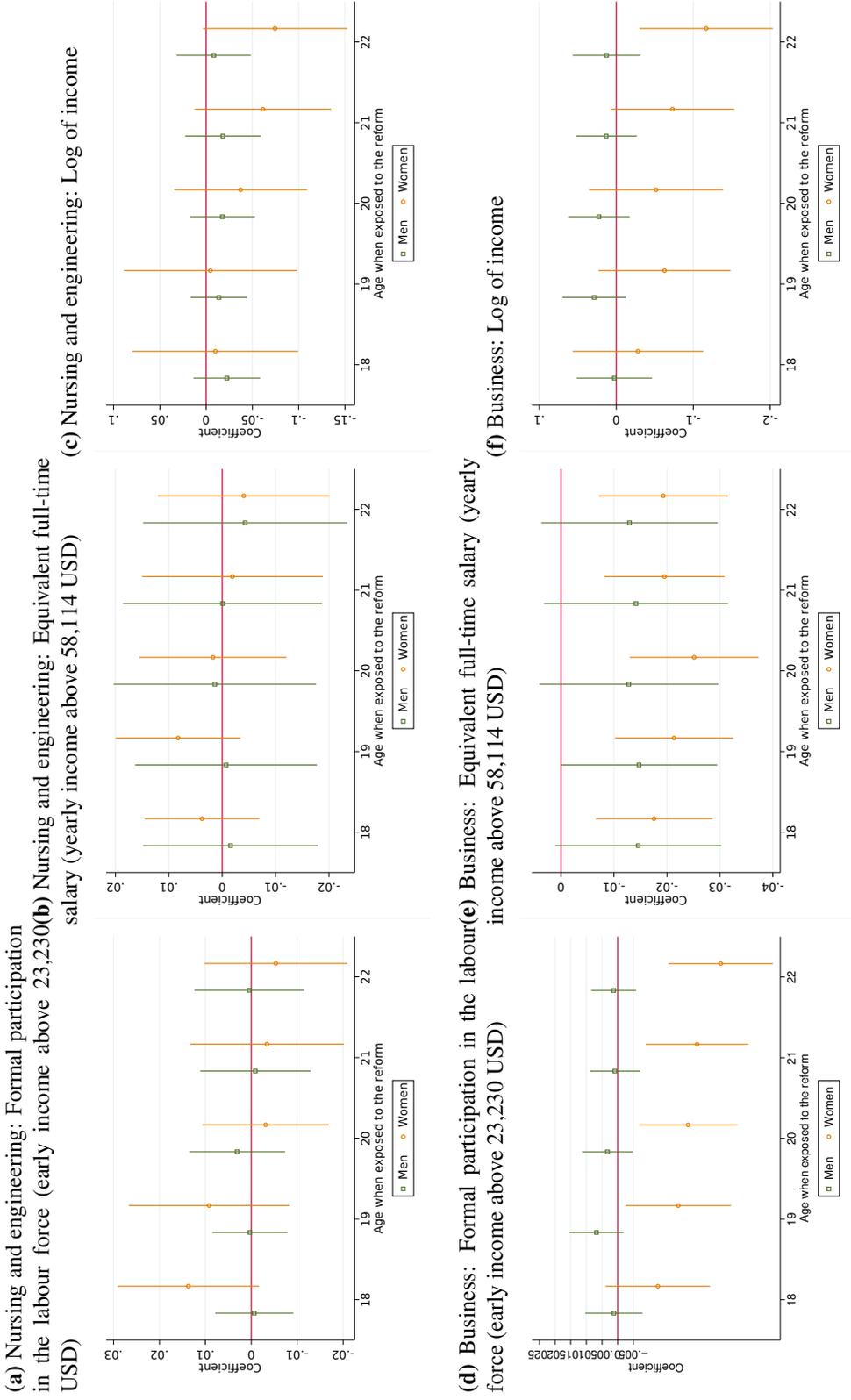
Notes: Reported are point estimates and corresponding standard errors from Estimating Eq (1) for each age cut-off where we compare individuals below and above the particular age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are heteroskedasticity robust and clustered at the municipality level. *p<0, 10, **p<0,05, ***p<0,01.

Table C.3. Baseline results for engineering

Age when reform implemented	All		M low ed		M high ed	
	Wom (1)	Men (2)	Wom (3)	Men (4)	Wom (5)	Men (6)
<=15	0.000 (0.002)	0.010** (0.005)	-0.001 (0.002)	0.004 (0.005)	0.002 (0.003)	0.016*** (0.006)
<=16	-0.000 (0.001)	0.010** (0.004)	-0.002 (0.001)	0.005 (0.005)	0.002 (0.003)	0.013*** (0.005)
<=17	-0.000 (0.001)	0.011*** (0.004)	-0.002 (0.002)	0.003 (0.004)	0.002 (0.002)	0.019*** (0.005)
<=18	-0.000 (0.001)	0.011*** (0.003)	-0.002 (0.001)	0.003 (0.004)	0.002 (0.003)	0.019*** (0.004)
<=19	-0.001 (0.001)	0.010*** (0.004)	-0.002 (0.001)	0.005 (0.004)	0.001 (0.002)	0.016*** (0.005)
<=20	-0.001 (0.002)	0.007** (0.003)	-0.001 (0.001)	0.004 (0.003)	-0.001 (0.003)	0.012** (0.006)
<=21	-0.000 (0.001)	0.008** (0.004)	-0.000 (0.002)	0.003 (0.003)	0.000 (0.003)	0.015** (0.007)
<=22	-0.001 (0.001)	0.006 (0.004)	0.000 (0.002)	0.004 (0.003)	-0.003 (0.003)	0.006 (0.008)
<=23	-0.000 (0.001)	0.004 (0.003)	0.001 (0.002)	0.003 (0.003)	-0.002 (0.002)	0.004 (0.007)
<=24	-0.001 (0.002)	0.002 (0.004)	0.001 (0.002)	0.003 (0.004)	-0.004 (0.003)	0.002 (0.007)
<=25	-0.002 (0.002)	0.002 (0.005)	-0.001 (0.002)	0.002 (0.005)	-0.003 (0.003)	0.003 (0.008)
<=26	-0.000 (0.002)	0.000 (0.005)	-0.000 (0.002)	0.002 (0.004)	0.001 (0.003)	-0.001 (0.010)
N	325275	363664	182422	207922	142853	155742
Mean						

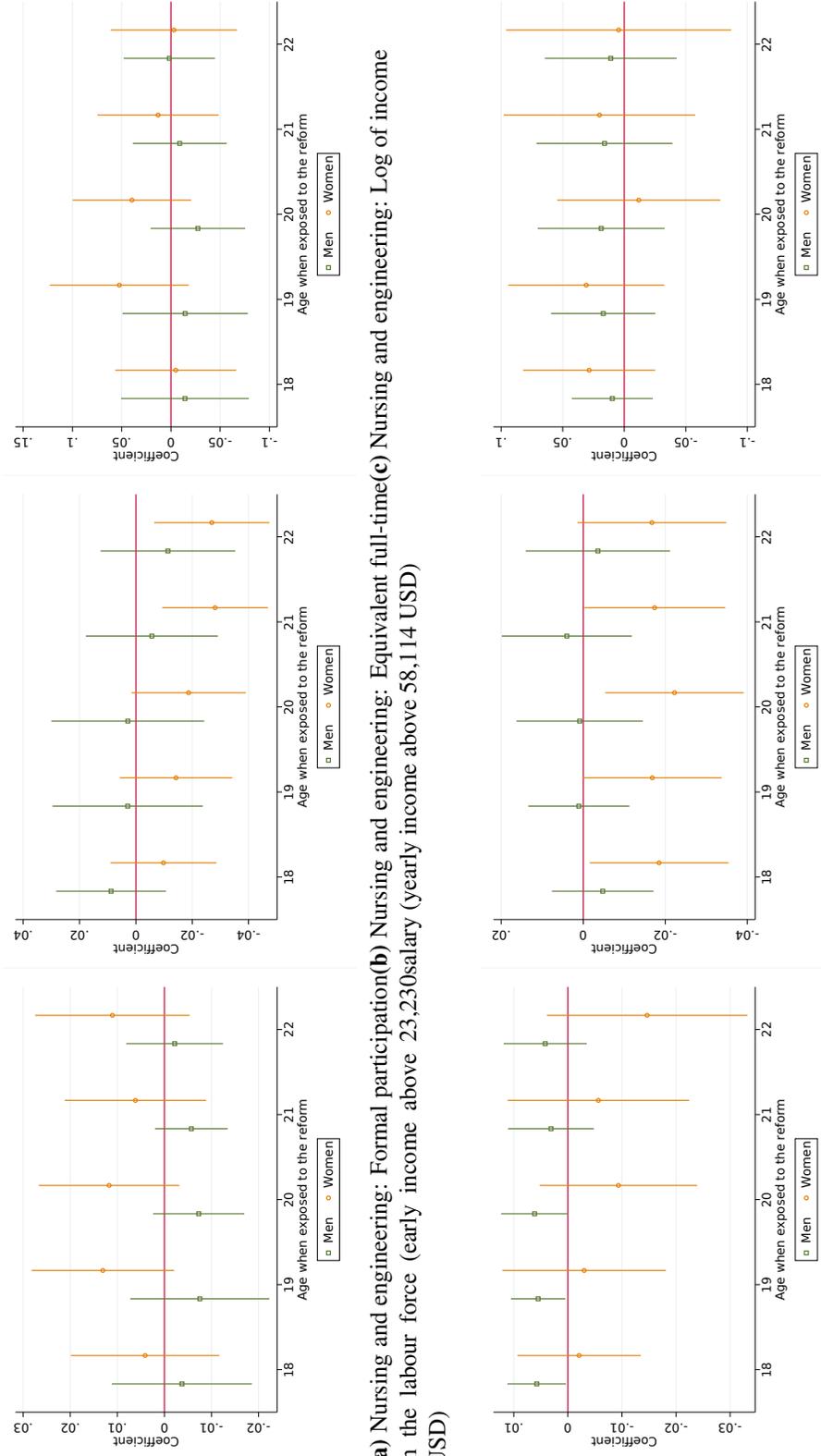
Notes: Reported are point estimates and corresponding standard errors from Estimating Eq (1) for each age cut-off where we compare individuals below and above the particular age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are heteroskedasticity robust and clustered at the municipality level. *p<0, 10, **p<0,05, ***p<0,01.

Figure C.4. The reduced form coefficients of the college reform on labour market outcomes for individuals with lower educated mother



Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

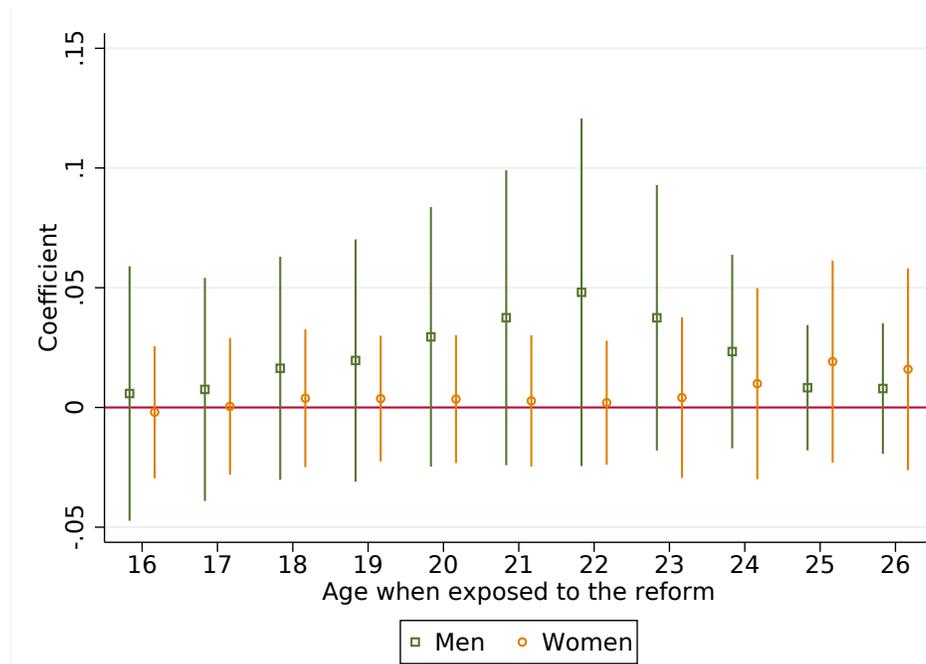
Figure C.5. The reduced form coefficients of the college reform on labour market outcomes for individuals with lower educated mother



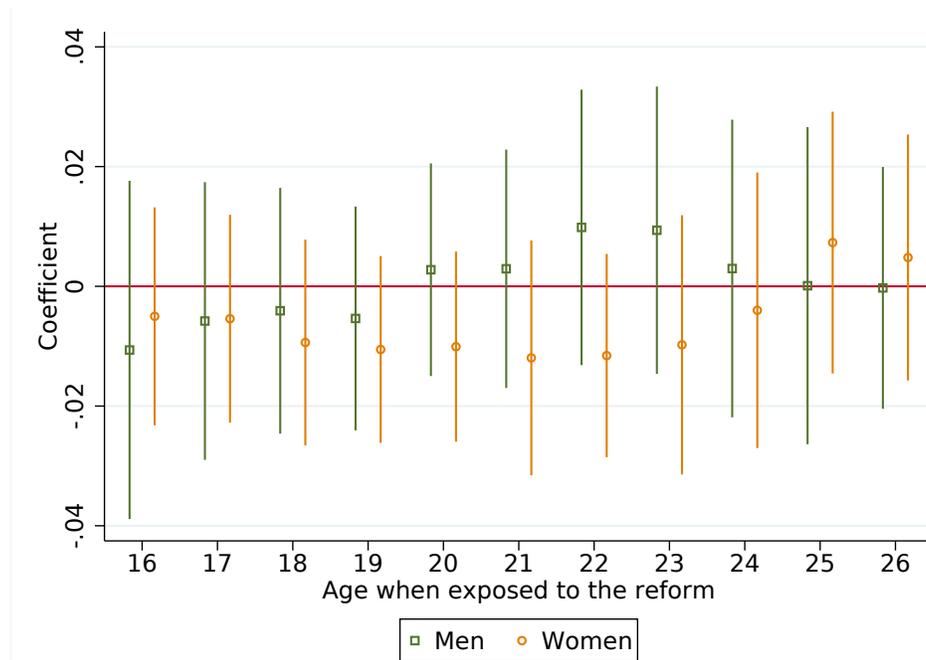
(a) Nursing and engineering: Formal participation **(b)** Nursing and engineering: Equivalent full-time(c) Nursing and engineering: Log of income in the labour force (early income above 23,230 salary (yearly income above 58,114 USD) USD)

(d) Business: Formal participation in the labour(e) Business: Equivalent full-time salary (yearly(f) Business: Log of income force (early income above 23,230 USD) income above 58,114 USD) Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

Figure C.6. The reduced form effects of the the opening of new nursing and engineering colleges on the probability of staying in the same municipality or region at age 35



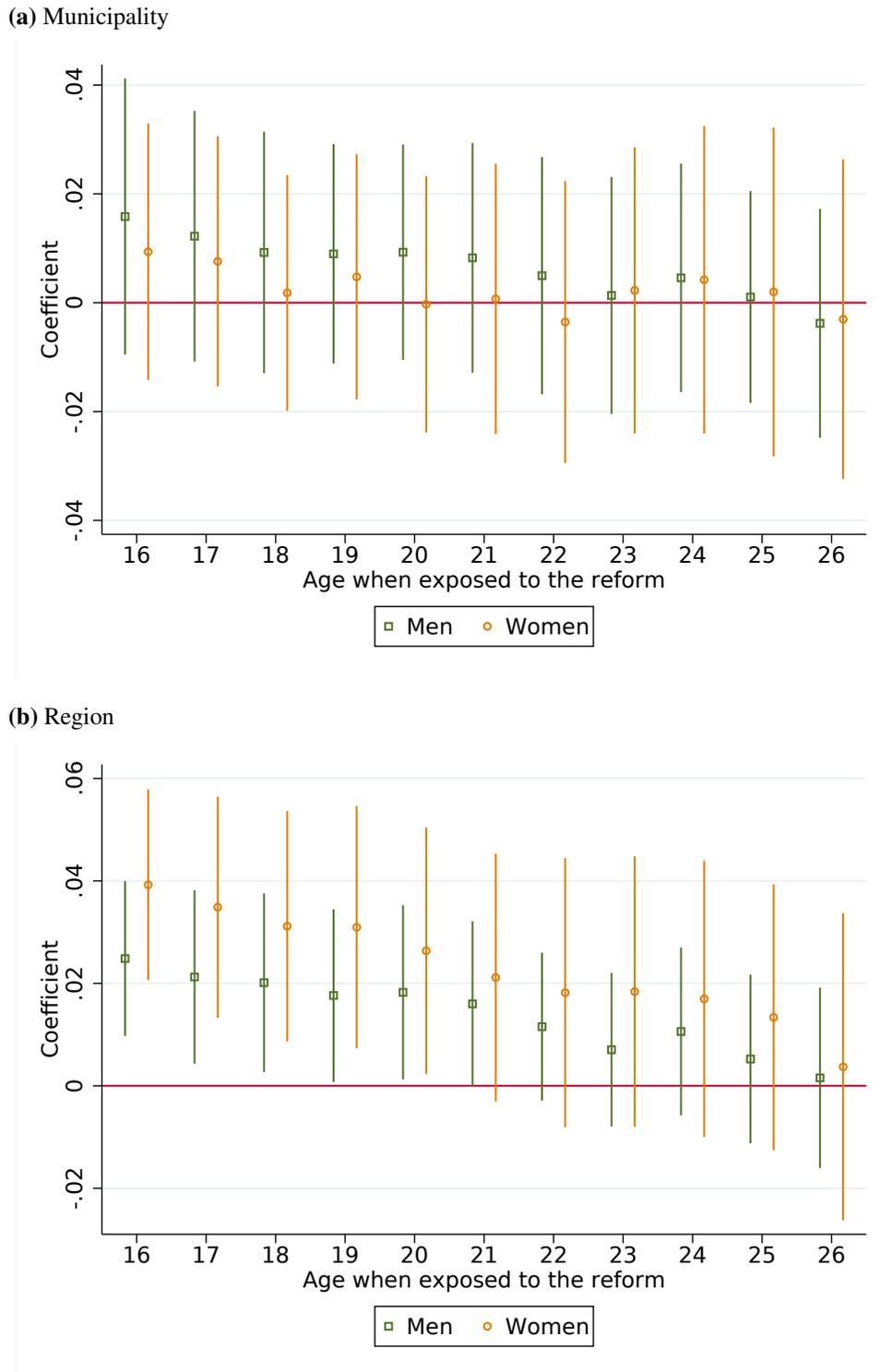
(a) Municipality



(b) Region

Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term.

Figure C.7. The reduced form effects of the the opening of business colleges on the probability of staying in the same municipality or region at age 35



Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalities with birth year) and a constant term. Standard errors are clustered at the municipality level.

Table C.4. Professions, contingent on having a degree in business and administration

	Men	Women
OCCUPATIONS CLASSIFIED AS MANAGEMENT POSITIONS		
Administrative and mercantile leaders	1245	613
Commodity production and service units	209	97
OCCUPATIONS CLASSIFIED AS ACADEMIC PROFESSIONS		
ICT advisors	592	649
Realister og civil engineers and such	330	116
advisors in finance, administration and sales	96	140
OCCUPATIONS CLASSIFIED AS COLLEGE CAREERS		
Professions within the culture and sport sector	969	1059
Engineers as such	236	75
employees in finance, administration and sales	85	143
OTHER OCCUPATIONS		
General office workers.	256	713
Other and unknown	1479	1686
Nr of observations	5497	5291