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

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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 higher education institutions were established in areas that did not previously have access to 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 that traditional gender differences persisted.

Keywords: University access, Gender wage gap; Field of study; Family background; Geospatial variation.

JELcodes: D31; I23; J62

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1 Introduction

Living near a higher education institution is associated with higher educational attainment (Card, 1995; Helland and Heggen, 2018; Frenette, 2009; Spiess and Wrohlich, 2010). However, less is known about how proximity to education institution shapes the choice of field of study. In this paper, we study how geographical expansion of higher education institutions in Norway during the second half of the twentieth century affected outcomes - in terms of choice of field of study, education length and participation in the labor market as adult - for individuals growing up close to these new college establishments. Between 1955 and 1989 a total of 33 new university colleges were established in Norway, with wide geographical dispersion, predominantly offering higher degrees in nursing, engineering, teaching and business administration. Pre 1950, higher education institutions in Norway were mainly located in the vicinity of the largest cites.

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. 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.[1] The increase in business continued for cohorts born between 1960 and 1970. These increases coincide with this regionally staggered expansion of university colleges, on which we base our identification strategy.

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 degrees being offered. However, men do not respond to the opportunity of taking a nursing degree, and women do not respond to engineering (STEM) degrees. This fits in with the general pattern seen in Norway and elsewhere,

[1] Other 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.

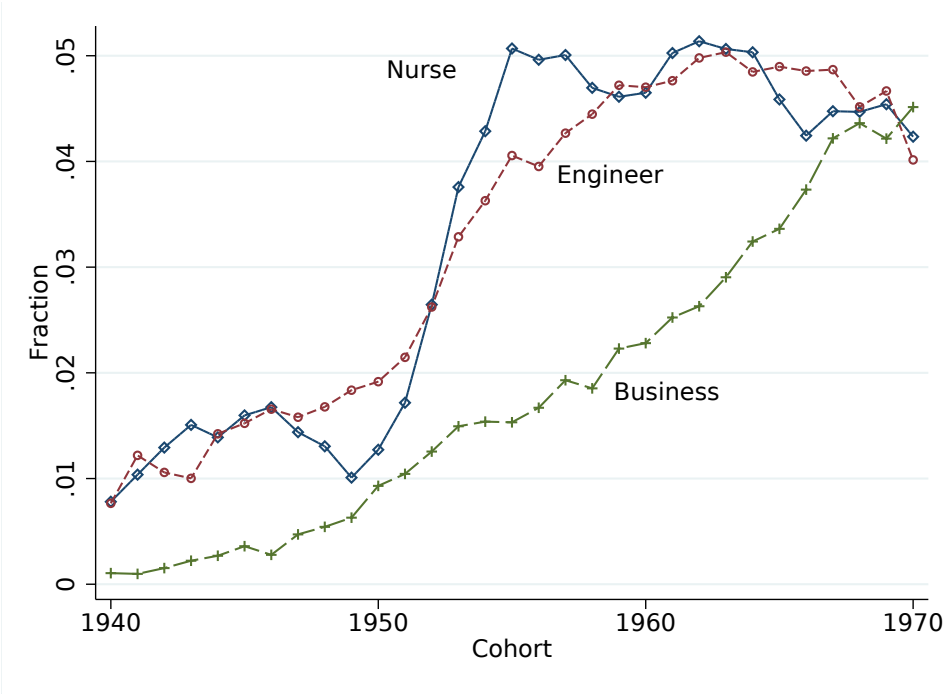


Figure 1. Fraction with a degree in nursing, engineering and business in Norway, by birth cohorts 1940-1973.

women often choose health related fields and work in the public sector, while men choose STEM related fields (Card and Payne, 2020). For business administration, the take up rates do not differ across men and women.

We find no increase in the overall educational attainment, implying that the local expansion of these new college degrees came at the expense of other (and more established) degrees at the same level not offered locally.[2] For women, the establishments of nursing colleges is negatively correlated with the the take-up of degrees in teaching. . For men, the new engineering colleges are negatively correlated with take-ups of degrees in other technological fields and business administration. Furthermore, when the new business administration degree was introduced, men chose it at the expense of engineering, while for women there are indications that the increase in this degree came at the expense of a degree in teaching and social sciences.

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 including the gender wage

[2]Gibbons and Vignoles (2012) also fail to find a negative link between geographical distance and participation in higher education in England. It only influences institutional choice.

gap (Altonji et al., 2012; Hastings et al., 2013; Kirkeboen et al., 2016). 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 not choose optimally. 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 with a new established higher education institution offering a college degree in business administration. We ask two questions in pursuit of 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.

This paper is related to three strands of the literature. First of all it contributes to the small literature looking at how changing prices can affect educational choices (Evans, 2017; Stange, 2015; Denning and Turley, 2017; Andrews and Stange, 2019), and in specific how local college access affects educational outcomes at the individual level (Doyle and Skinner, 2016; Suhonen and Karhunen, 2019). Even though tuition fees are non-existing for public education at all levels in Norway, the large land surface of Norway combined with scattered settlement involves substantial living and travel cost for individuals who have to leave their home-region to take higher education (which was the case pre 1950). Our findings indicate that changing the costs by reducing distance to college can alter educational choices. However, distance to college does not seem to be important in influencing the decision

on whether or not to enroll in higher education.

Second, our paper is also a contribution to the growing literature that seeks to understand differences in field of study choices by gender(e.g. Wiswall and Zafar, 2018; Delaney and Devereux, 2021) and how women and men respond differently to changes in educational policies (Sekhri et al., 2022; Joensen and Nielsen, 2015). This reform did not induce women to become engineers nor men to become nurses. We find that the establishment of engineering colleges increased up-take only among men whose parents had higher education, while nursing appears to have affected all women.

Finally, we also add to the literature looking at the importance of the location of higher education institutions. Andersson et al. (2009) and Carneiro et al. (2022) study how geographical expansion of higher education institutions in Scandinavia affect local productivity. Russell et al. (2022) find that counties in the U.S. where colleges were located have higher local educational attainment today than counties that were considered to become college sites. Our study shows that in the Norwegian context regional investment in colleges did not increase the local education level, but may have had an effect on individual's propensity to remain in the area. Geography and place are important in shaping opportunities (Chetty et al., 2014; Markussen and Roed, 2018). Local provision of higher education may be an important mechanism in shaping the attractiveness of a neighborhood

The location of the colleges was 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 (Johnsen, 1999; Ottoesen, 1969; Knutsen, 2017).[3]

To ensure that our results are not driven by 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 one intention of establishing colleges across the country was to increase access to higher education, our results indicate that the people growing up in the affected areas seem not to have

[3]Most 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 college locations.

changed their study length. Such policies may have a larger effect in settings where moving is more costly and education scholarships less generous than in the case of Norway in this period. 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.

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.

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.[4] In addition to socioeconomic background, 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). After World War 2 (WW2), policies 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 administration - at the regional level. In Norway, university colleges, for simplicity also denoted "colleges" in 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. Before WW2 only the three largest cities (Oslo,

[4]This information is obtained here: https://www.ssb.no/befolkning/artikler-og-publikasjoner/si-meg-har-du-studert

Bergen and Trondheim) and central municipalites located close to the biggest cities offered higher education at the university- and university college level.[5] Politically it was therefore emphasized that the new colleges should be spread around the country. Thus, the location of colleges was to a large extent regarded as a regional policy measure (Norwegian Ministry of Education, 1975).

The exact location of the regional colleges was decided by the parliament, where it was subject to extensive debate. Even though recruitment of students and professional environment were supposed to be considered, debates in the parliament suggest that 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.

As a result of this targeted district policy measure, the number of colleges outside of the biggest cities increased substantially in the period after WW2. 9 new nursing colleges, 11 new engineering colleges and 13 business colleges were spread around the country. Figure 3 shows maps of the location of new colleges (established after 1940) offering a degree in nursing, engineering and business administration. The red dot indicates the exact location of the new colleges. The dark blue areas are commuting zones which will be discussed in Section 3. Note also that a degree in business administration at the college level did not exist in Norway before 1969. However, approaching 1990 each county/district was covered. Table A.1 in the Appendix gives an exact overview over year of establishment and localization. A thorough description of the establishment of these education institutions is given 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). As shown in Figure 2, only 2.2 percent of the 1940 birth cohort had a college degree. This share increased to almost 7

[5]In the period before 1940, there were ten 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.

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 administration degree from 1969 and onwards.

Tertiary education in Norway relies mainly upon public funding. Public universities and colleges 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 percent of those that applied, were granted a scholarship and loan (Ministry of Education, 1969).[6] Thus, the private cost of education was mainly the opportunity cost of not working and potentially moving costs.

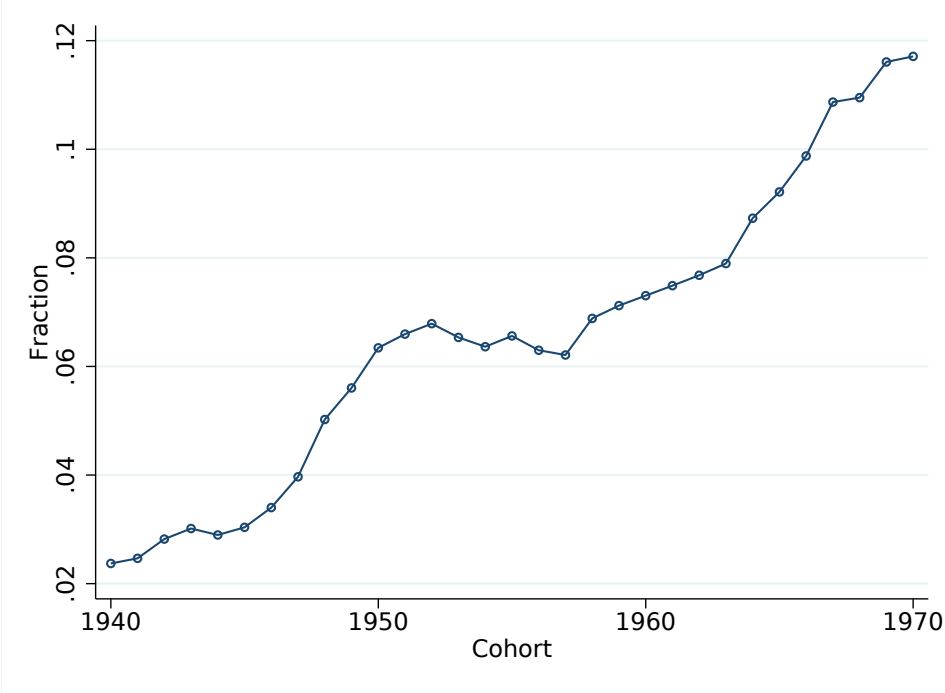


Figure 2. The fraction with a college degree in Norway, by birth cohort

[6]Lånekassen, 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 means-testing was relaxed and new education institutions were eligible. In the early 1960's the majority of students were receiving loan and scholarship (Røseth, 2003).

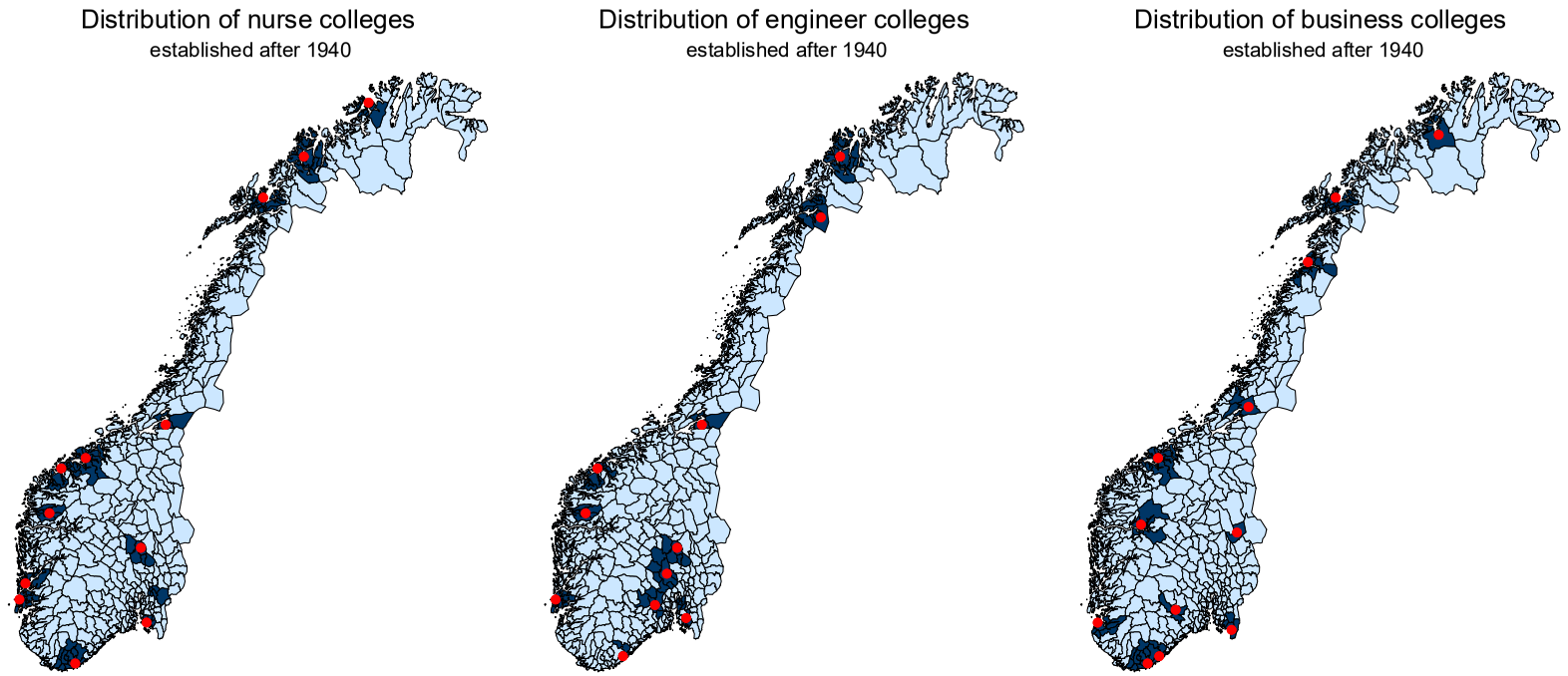


Figure 3. Location of nursing, engineering and regional colleges established after 1940, with commuting zones highlighted

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. 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 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 administration track, that was first introduced in 1969, a high school diploma has always been required in order to enrol.

Moreover, there was a tendency in 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. This is the reason why we look at a wide range of age thresholds in our regression specification.

2.3 Business administration degrees

A new 2-year college degree in business administration (''økonomi og administrasjon'') was introduced with the establishment of the regional colleges and its curriculum was determined by the central government: About sixty percent of the curriculum was 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.[7] The idea was that the degree-holders could enter management and leader positions in local firms. In this way, the new colleges were

[7] All regional colleges, with an exception of the one in Lillehammer offered this degree from the start.

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 nursing school, while later a diploma from upper secondary school (videregående) was needed. Individuals in our sample are born between 1940 and 1973, hence for a 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 students 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 years.[8]

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, or 2 years for students who had completed the science track in high school.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.

[8]The 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.

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. The census of 1960, as well as later censuses, can also be linked using the personal identification number.

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. 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 municipality borders of 1980.[9] 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. The reason for using the registered municipality at 16 is to reduce the systematic difference in how we measure municipality of residence, between older and younger cohorts. However, we also do robustness tests using the municipality of residence when individuals are 10 years old, excluding older cohorts for whom we do not have this information. Individuals with unknown municipality (around 3 per cent, mostly immigrants) and individuals registered as living outside Norway 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 colleges that we base our identification on. A $municipality_i$ is defined as being within commuting distance of

[9] A 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.

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.

NUDB has every education initiated linked to a national identity number. This implies that we can track every individual's educational career. In order to obtain a data set with one observation per individual, the data is collapsed on the highest education level initiated 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 contain 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.[10]

[10]Complete 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.

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. 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. 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 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 187 000 and 468 000 nok [11] . Both income and the pension base rate are adjusted for wage inflation. Earning of at least 187 000 nok (two times the pension base rate) is an indication on whether the individual participates in the formal labour market, whereas earning at least 467 500 nok (five times the pension base rate) 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 1and 0 otherwise. We also report the results using log of income as the outcome variable, excluding those with zero income.

[11] This corresponds to approximately 23 370 USD and 58 500 USD with a currency exchange rate of 8 nok to 1 dollar

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.[12] 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 three degrees are more common among people whose parents have higher education than among individuals of lower educated parents.[13] Turning to labour market outcomes, more men than women earn above both the high and low income threshold, and the fraction is 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.

3.5 Empirical strategy

Does reduced distance to college affect the decision to take higher education and which field to specialize in? Distance to college may not be exogenous to unobserved factors which also affect future labor market outcomes and the relationship between college proximity and educational attainment may be a spurious one. We propose to solve this problem by exploiting the time-variation in the roll-out

[12]The 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.

[13]An 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 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						
- >2G (187 000 nok)	0.75	0.92	0.71	0.92	0.82	0.94
- >5G (467 500 nok)	0.24	0.69	0.17	0.65	0.32	0.74
- average	168 185	285 223	144 963	257 126	197 914	322 813
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						
- >2G (187 000 nok)	0.76	0.92	0.71	0.91	0.81	0.93
- >5G (468 000 nok)	0.26	0.71	0.18	0.66	0.34	0.75
- average	173191	296382	146694	262108	202122	335278
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.

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 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.[14] 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

[14]We 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.

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 affected. These results are reported in Section 4.5.

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 although this 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, corresponding to part-time work and full-time work, as outlined above. Additionally, we 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 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. Geographical expansion of higher education has been shown to affect productivity, skilled wages and innovation (Carneiro et al., 2022; 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 compostion 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

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

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 were they were established later or had a different share of the population working in industry or the service sector. In addition, we check whether the voting share for the labor party or the conservative bloc can predict college location as it is possible that the party in power could favor its own voters when deciding where to locate a college. 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 socioeconomic 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, i.e. 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 dummy variables controlling for 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. 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 similar probabilities 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.[15]

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.[16]

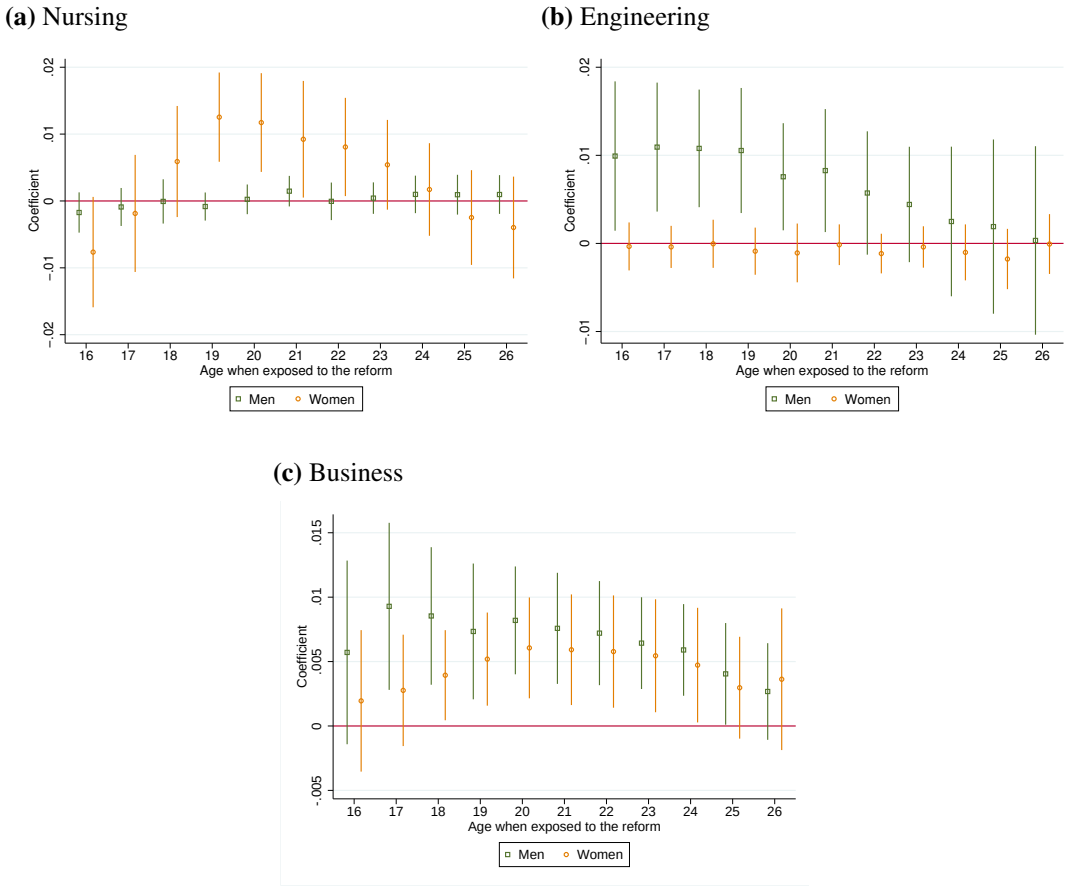
4.2 Heterogeneity with respect to parental background

In Figure 5 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

[15] All these results are also presented in column (1) in Appendix Table C.1 and C.2.

[16] 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.

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



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 municipalites with birth year) and a constant term. Standard errors are clustered at the municpality level.

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 columns (2) and (3) in Appendix Figure C. In the sample period we focus on, mothers had lower education than the fathers. The results are unaltered if we stratify on fathers' education.

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 (187 000 nok)[17] as an indication to what extent the individual participates in the formal labour force, and equivalent full-time salary (467 500 nok)[18] 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 also investigate the intensive margin.

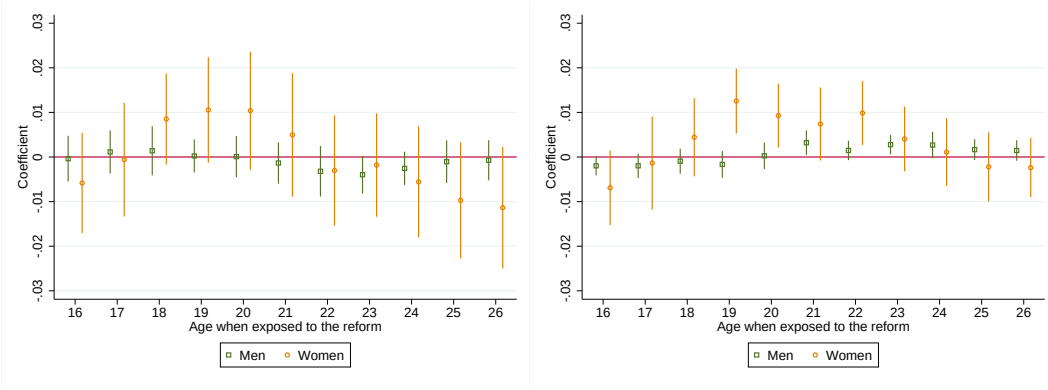
For both nursing and business, but also to a large extent engineering, the effects on the take up rate of the different degrees seems to be largest for individuals who are between 18 and 22 when treated for the first time (where 19 means 19 years or younger when the college is established, 20 is 20 years 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 form effects for women exposed to new nursing colleges and men exposed to new engineering colleges,

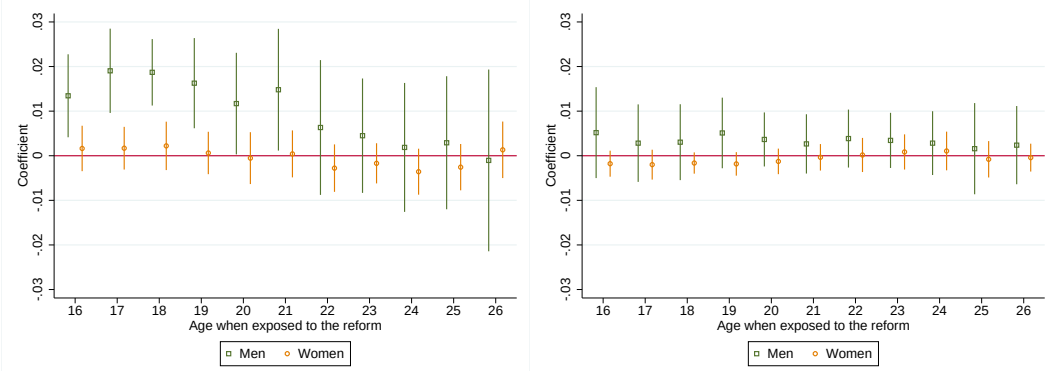
[17]This figure equals two times the pension rate mentioned in subsection 3.3.
[18]This figure equals five times the pension rate mentioned in subsection 3.3.

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

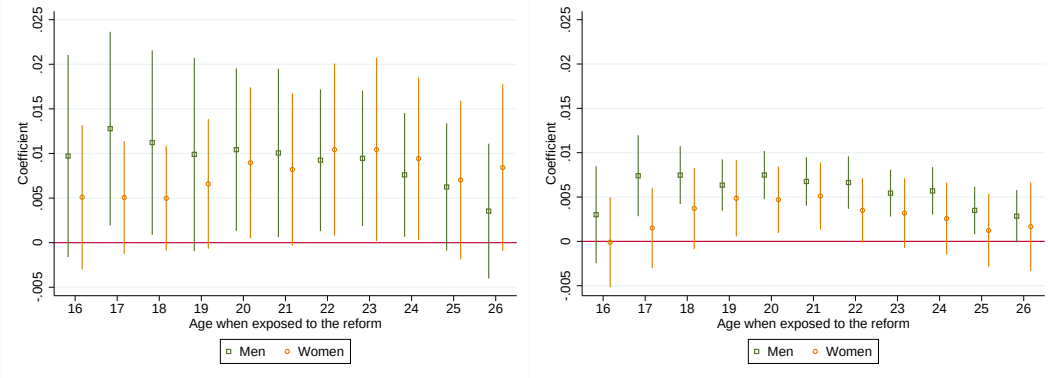
(a) Nursing



(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 municipalites with birth year) and a constant term.Standard errors are clustered at the municpality level.

whereas we in the lower panel report results for men and women exposed to new business colleges.

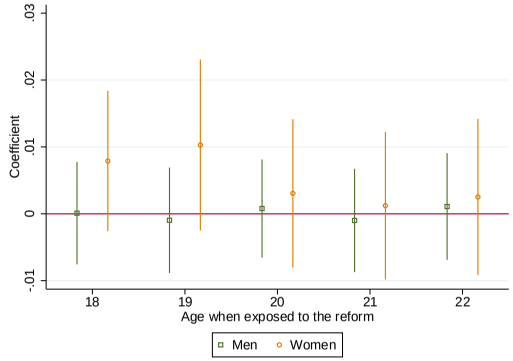
For nursing and engineering there are no effects of college openings on neither participation in the formal labour force, working full time nor earnings on the intensive margin. For business on the other hand, men who get access to a college degree in business seem to perform better in the labour market 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 earnings on the intensive margin. For women the 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 Figure C.1 and C.2 where we stratify on mothers education. The negative effect of the openings of business 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.[19]

However, when looking at the available data on occupation we find that, contingent on having a degree in business (10,788 individuals), 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 the variation 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 of this is reported in Appendix Table C.3.

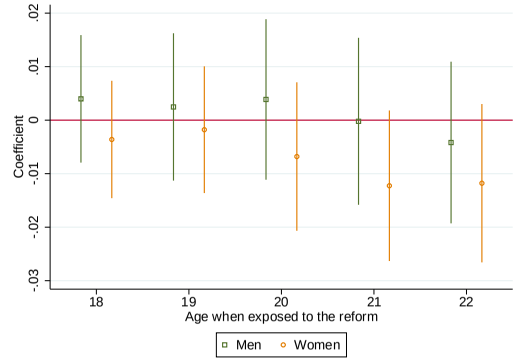
[19]Occupation data for some sectors of the economy (with highest quality for the private sector) are available annually from 2003, and there are full-count censuses every decade until 1980 (and a smaller sample for 1990).

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

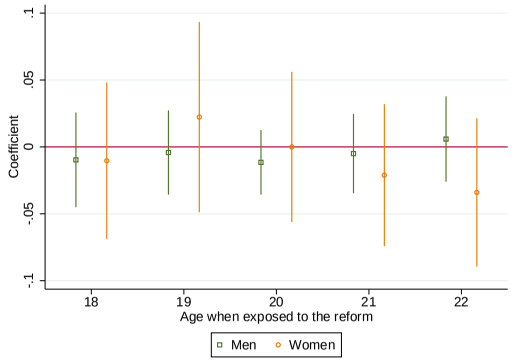
(a) Nursing and engineering: Formal participation in the labour force (early income above 187 000 nok)



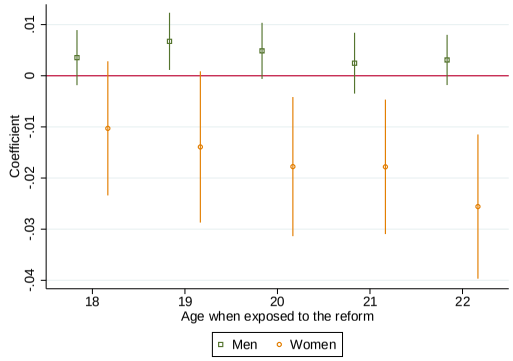
(b) Nursing and engineering: Equivalent full-time salary (yearly income above 467 500 nok)



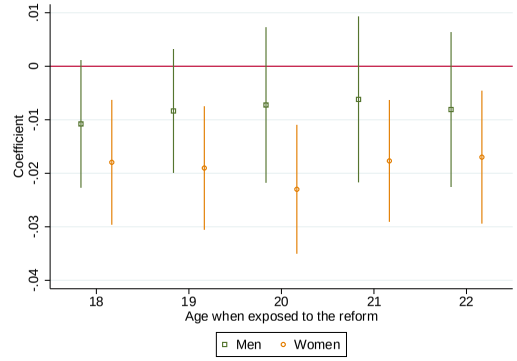
(c) Nursing and engineering: L of income



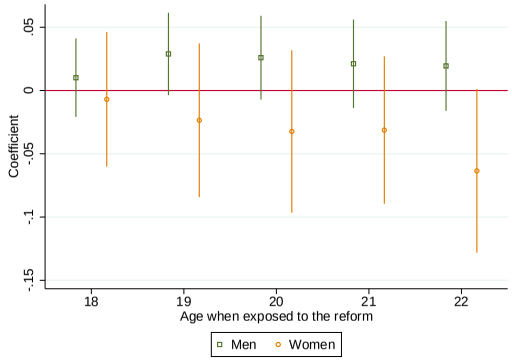
(d) Business: Formal participation in the labour force (early income above187 000 nok)



(e) Business: Equivalent full-time salary (yearly income above 467 500 nok)



(f) Business: L of income



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 municipalites with birth year) and a constant term. Standard errors are clustered at the municpality level.

We also check whether being affected by college openings in nursing, engineering and business affect the probability of moving. In Appendix Figure C.3 and C.4 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 administration, we focus on both men and women. For nursing and engineering (Figure C.3) the point estimates are in most cases very imprecise. For business administration (Figure C.4) 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.

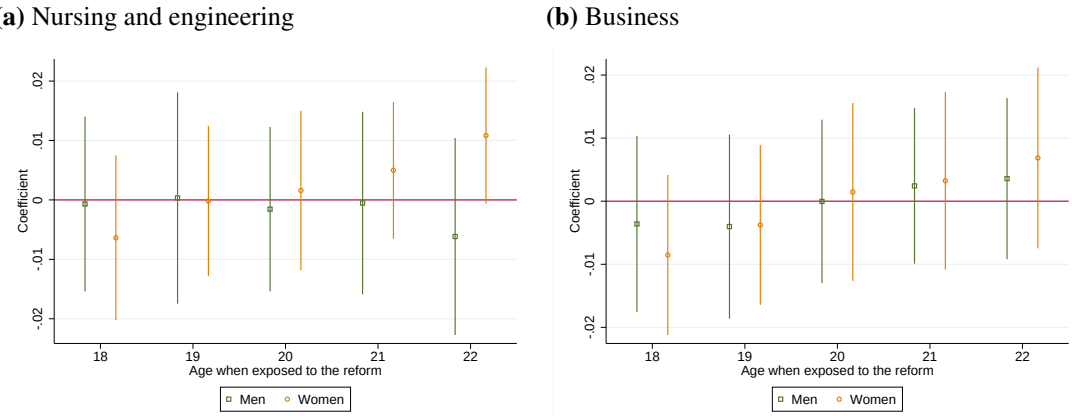
In order to better understand the results in this section, we now turn to investigate the counterfactual outcomes: What would the treated individuals have done in the absence of the establishment of colleges in nursing, engineering and business administration? .

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

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 municipalites with birth year) and a constant term.

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 and business colleges did not affect the probability of taking higher education. This finding implies that the reform 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 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. [20]

The Norwegian education data base (NUDB) uses the following categories of fields: Teaching, technology, administration, health, social science and humanities.[21] In these registries technology

[20]The 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.

[21]As 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 securtity (for

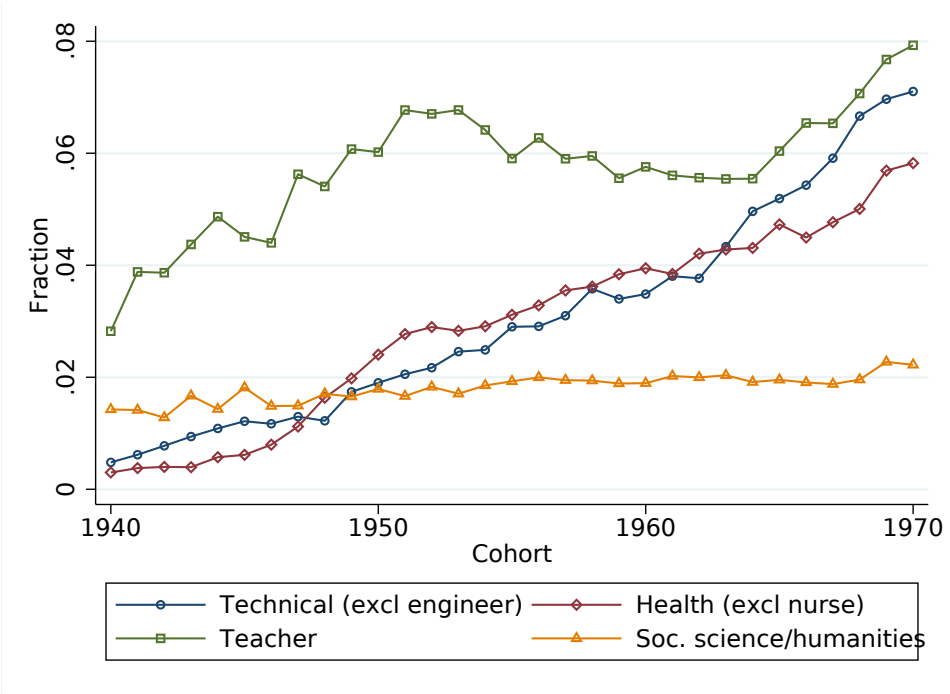


Figure 8. The fraction with a degree teaching, health (excl. nursing), technical subjects (excl. engineering), social science and humanities.

includes STEM subjects, administration includes business, accountancy and management, while social sciences consists of degrees such as law, political science and sociology. Other degrees 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 administration). In all

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.

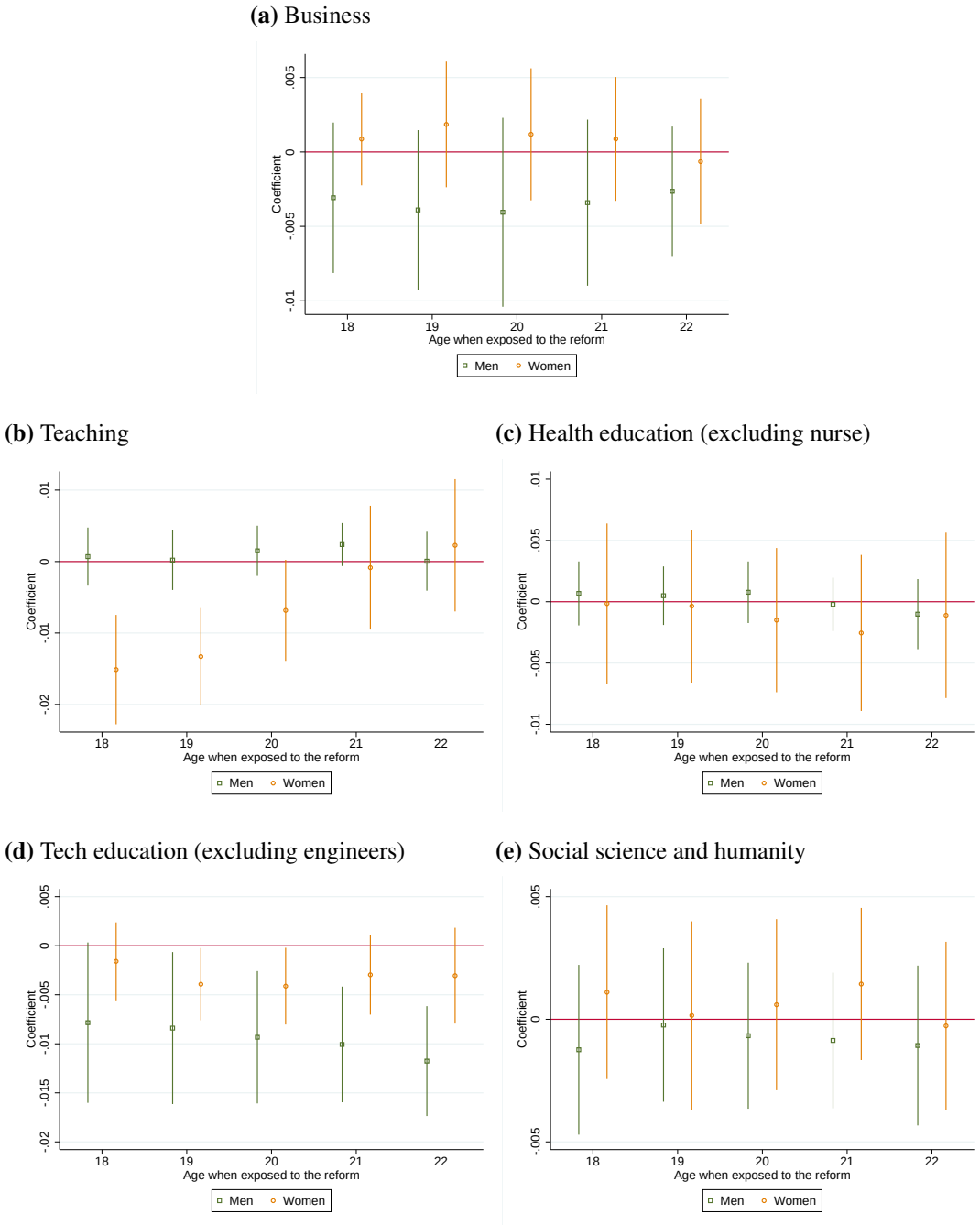
specifications we include the same control variables as in Figures 4 and 5. The only field which is negatively affected by the opening of new nursing colleges, is teaching which suggest that women living in regions with newly opened nursing colleges would have become teachers in the absence of access to a nursing college. As already illustrated in Figure 8, the fraction taking a teaching 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 administration is also negative, but not 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.

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.[22] Third, we check whether our results are robust to using Classification of Economic Regions, which is based on recent commuting data (Statistics Norway, 2000). As can be seen in Figure 11, this does not seem to affect the results.

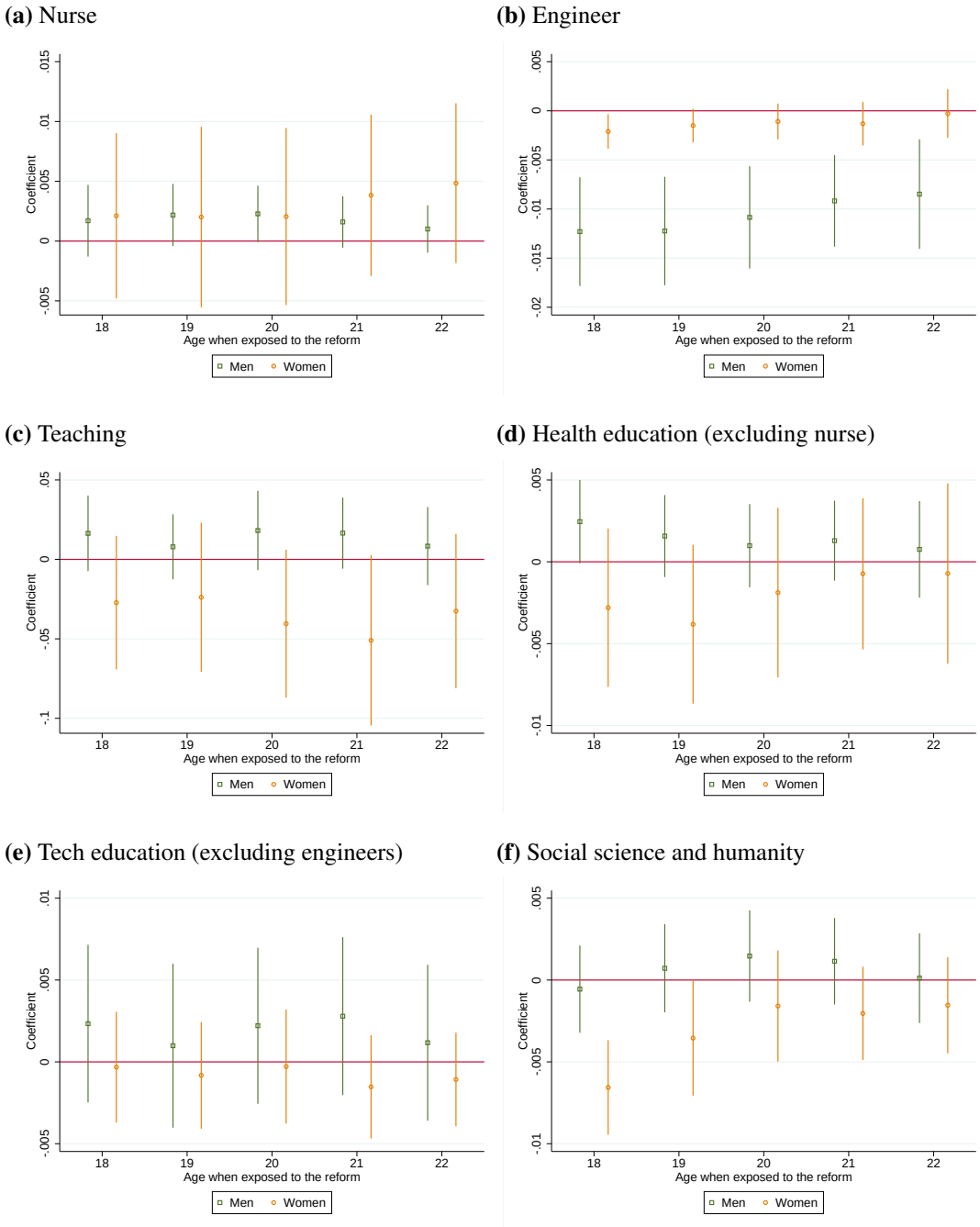
[22]The distance is measured using the coordinates of the administrative centre of a municipality

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



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 municpality level.

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



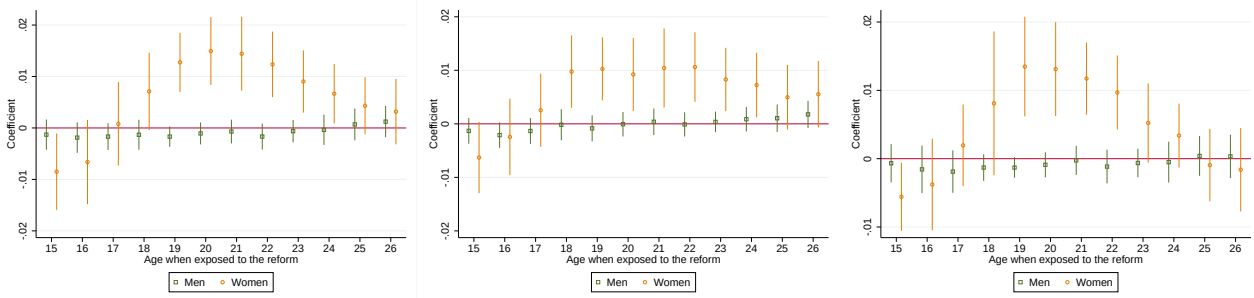
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables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

Second, to address that parents may move to a municipality with a college before the age of 16 we estimate the baseline equation measuring residential municipality when an individual is 10 instead of 16.[23] 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 Figure4 .

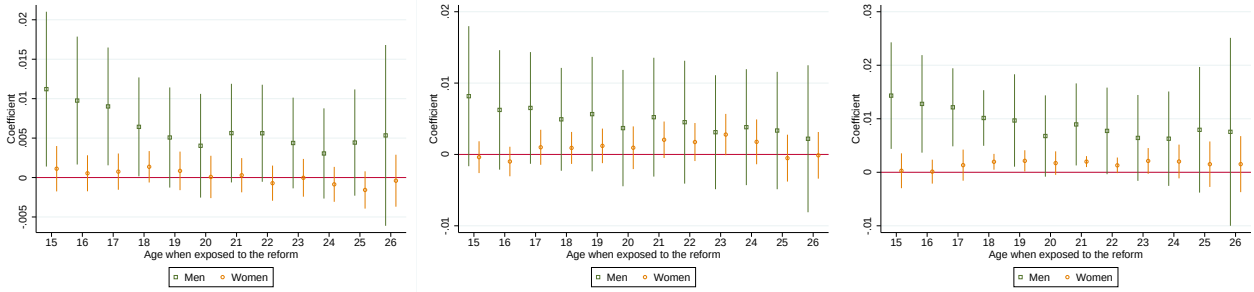
[23]The reason why we choose 16 instead of 10 as the baseline is that the first time we observe municipality of residence is in the 1960 census, and we can therefore only use cohorts born after 1950.

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)

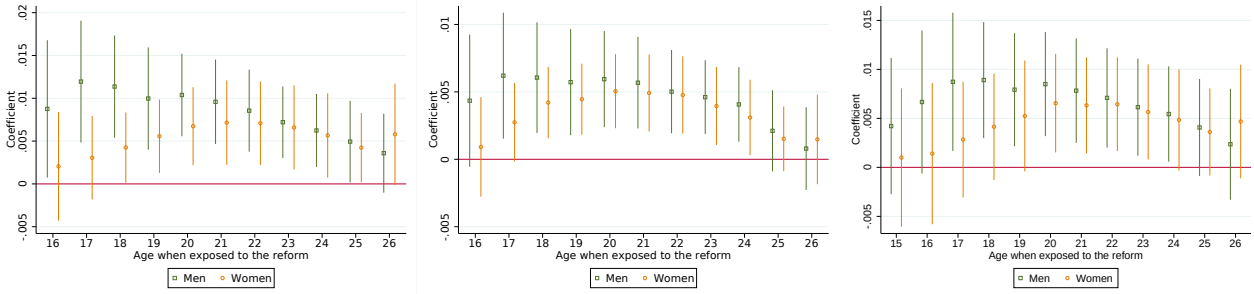
(a) Nurses



(b) Engineer



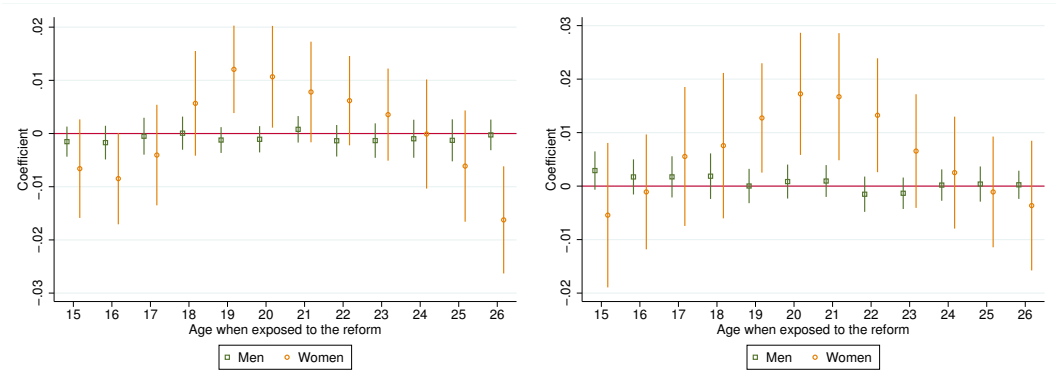
(c) business administration



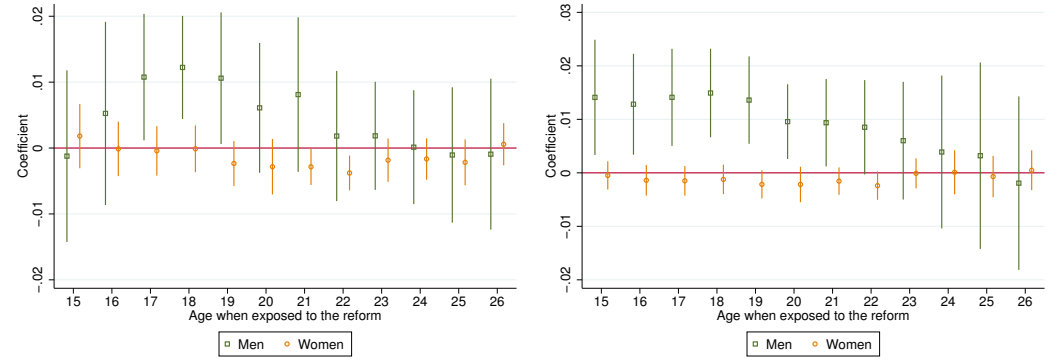
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in specifications in panel a and b are municipality fixed effects, dummy 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 municpality 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)

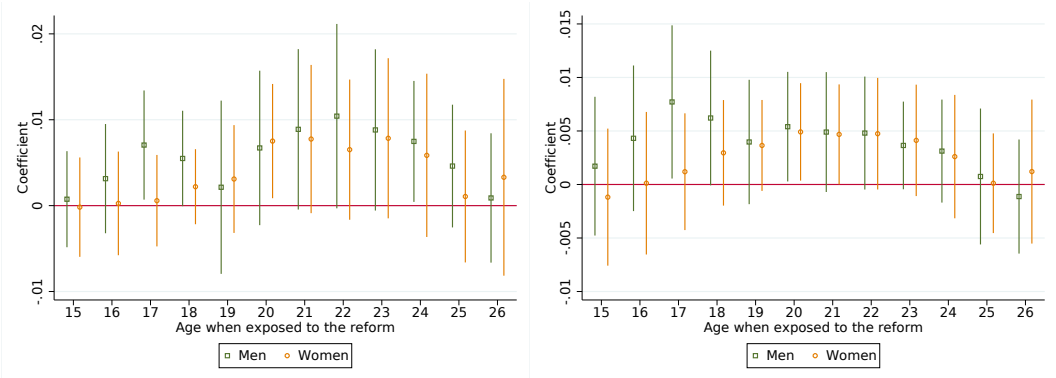
(a) Nurses



(b) Engineer



(c) business 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 municpality 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. 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

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	Sndal
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

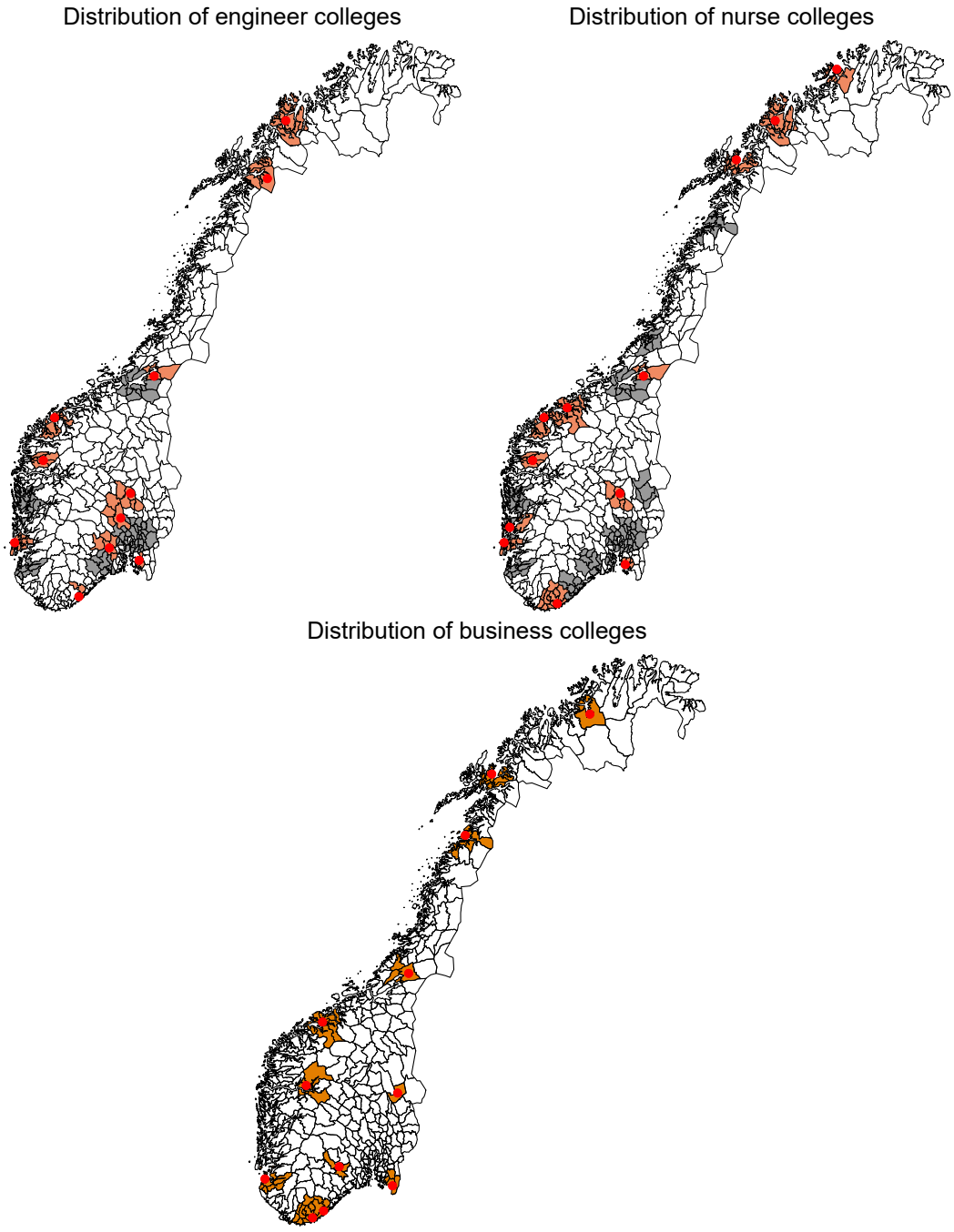


Figure A.1. Maps showing commuting zones for colleges established before and after 1940

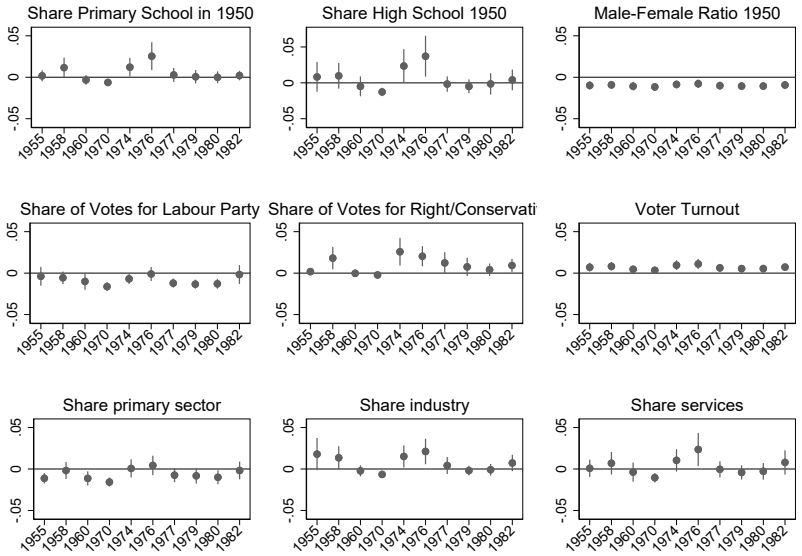
Notes: The maps show the commuting zones that got new colleges after 1940 in orange, whereas the red dots indicate the exact college location. The grey areas are the zones with college access before 1940[a]

[a]There were no business colleges before 1940, therefore no grey areas.

B Year of establishment and municipality characteristics

Figure B.1. Timing of reform and municipality baseline characteristics: Nursing colleges

(a) Nursing colleges and 1950 characteristics: Plot of coefficient from eq 3.6



(b) Nursing colleges and 1960 characteristics: Plot of coefficient from eq 3.6

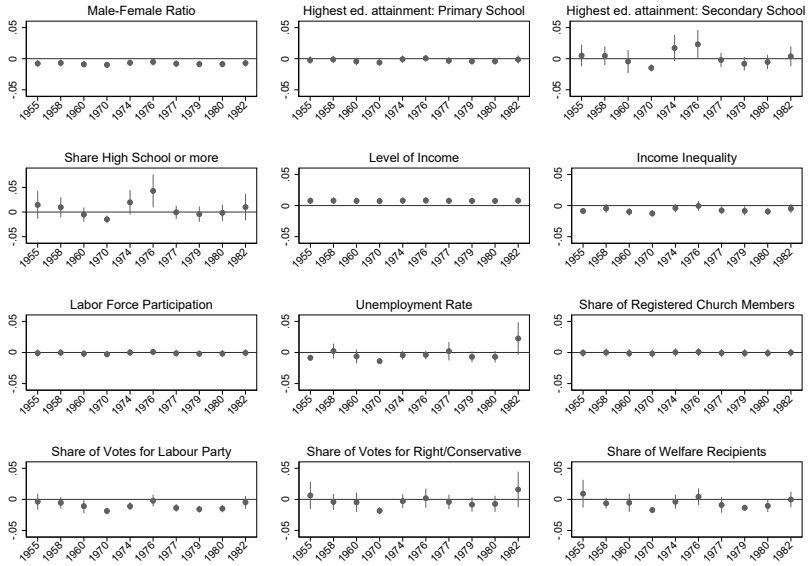
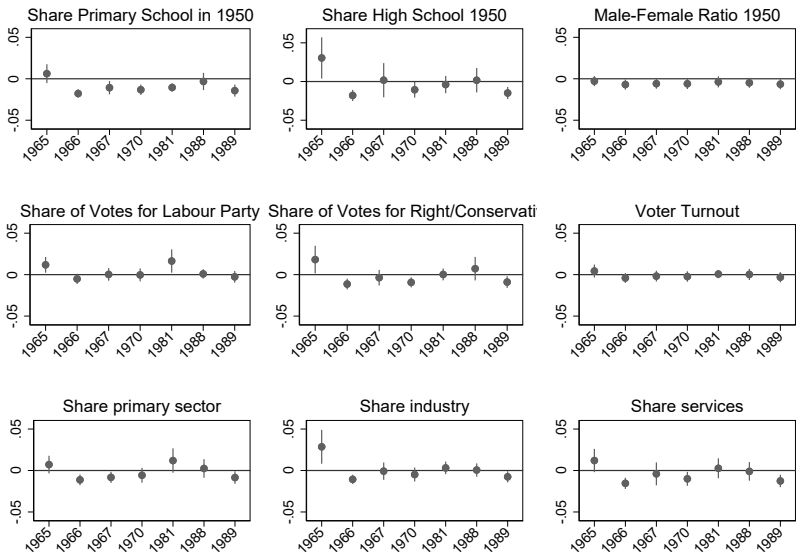


Figure B.2. Timing of reform and municipality baseline characteristics: Engineering colleges

(a) Engineering colleges and 1950 characteristics: Plot of coefficient from eq 3.6



(b) Engineering colleges and 1960 characteristics: Plot of coefficient from eq 3.6

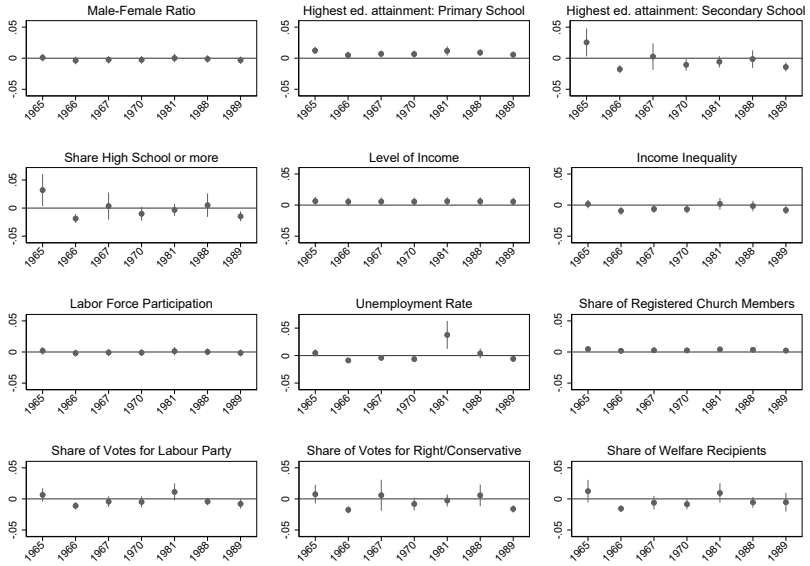
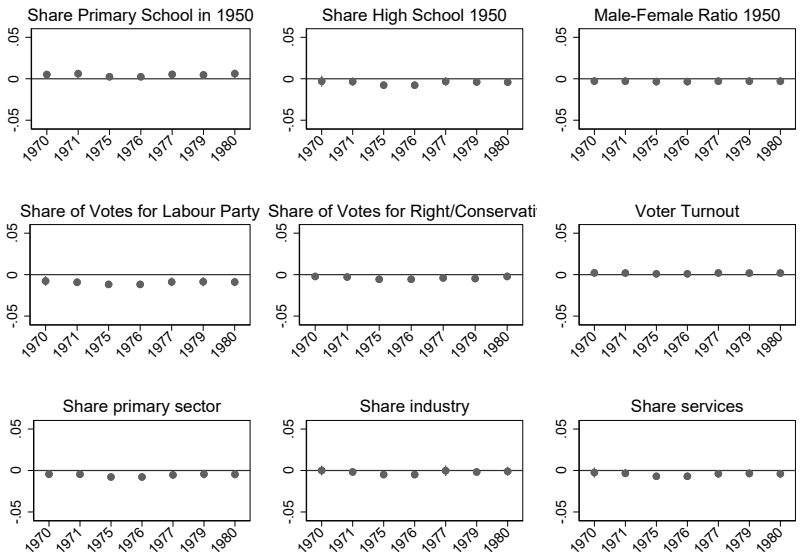
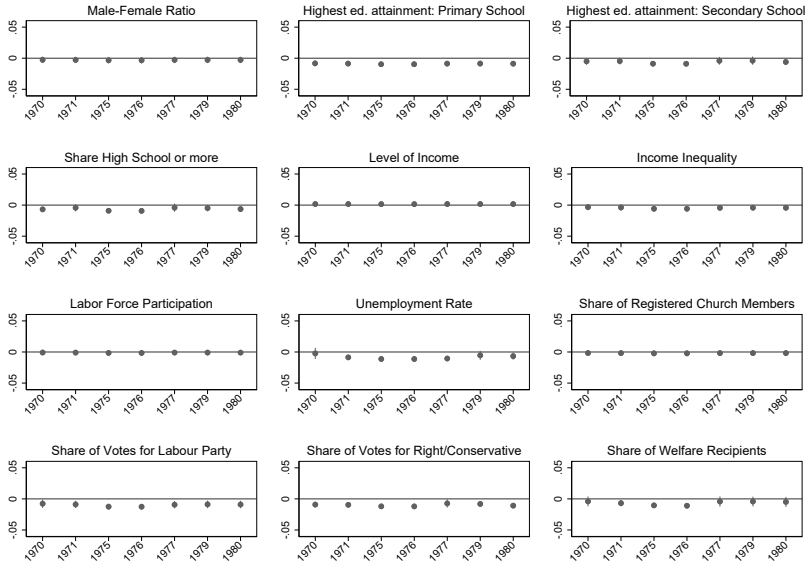


Figure B.3. Timing of reform and municipality baseline characteristics: Business colleges

(a) Business colleges and 1950 characteristics: Plot of coefficient from eq 3.6



(b) Business colleges and 1960 characteristics: Plot of coefficient from eq 3.6



C Results: degree attainment and labour market outcomes

Table C.1. Baseline results for nursing

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

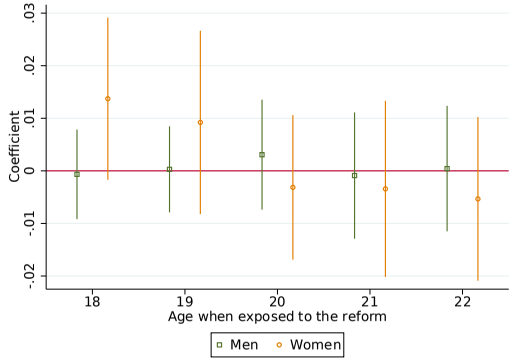
Table C.2. Baseline results for engineering

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

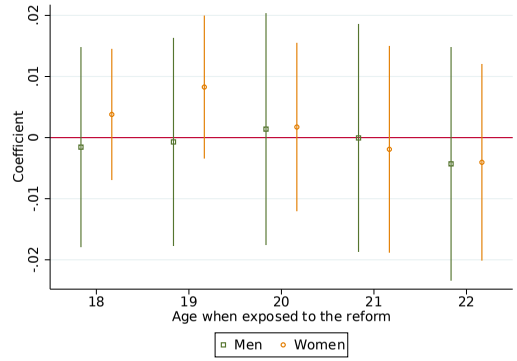
Notes: Reported are point estimates and corresponding standard errors from Estimating Eq (1) for each age cut-off where we compare individuals below and above the particular age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables for birth year, compulsory schooling reform, and municipality specific time trends (where we interact municipalites 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.1. The reduced form coefficients of the college reform on labour market outcomes for individuals with lower educated mother

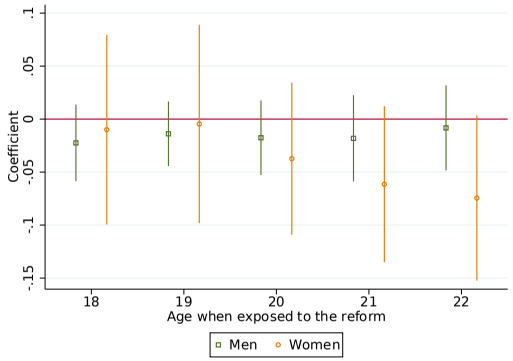
(a) Nursing and engineering: Formal participation in the labour force (early income above 187 000 nok)



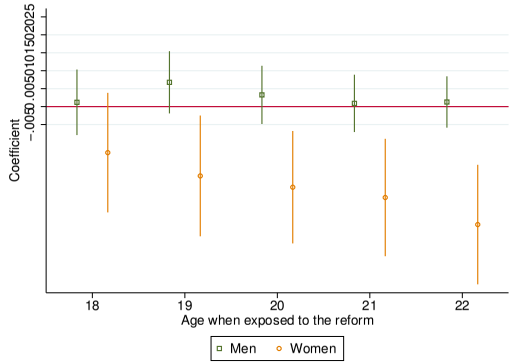
(b) Nursing and engineering: Equivalent full-time salary (yearly income above 467 500 nok)



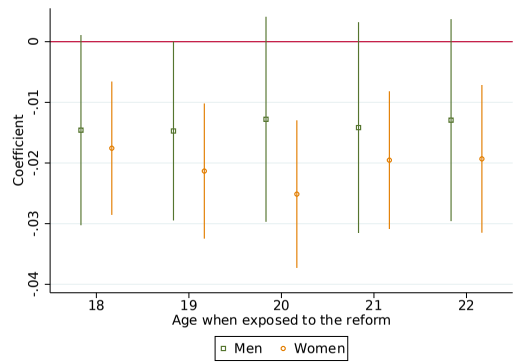
(c) Nursing and engineering: L of income



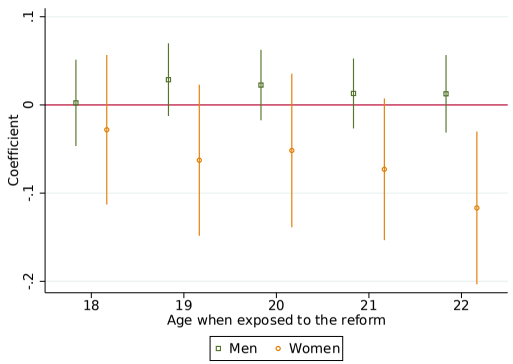
(d) Business: Formal participation in the labour force (early income above 187 000 nok)



(e) Business: Equivalent full-time salary (yearly income above 467 500 nok)



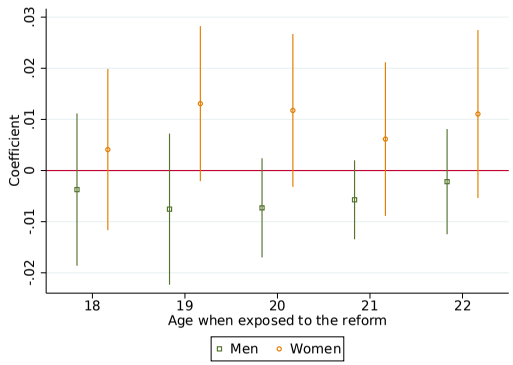
(f) Business: L of income



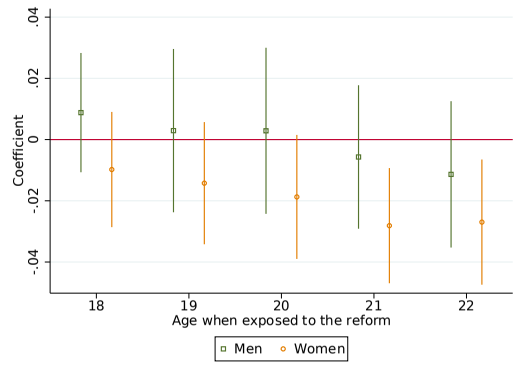
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables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

Figure C.2. The reduced form coefficients of the college reform on labour market outcomes for individuals with lower educated mother

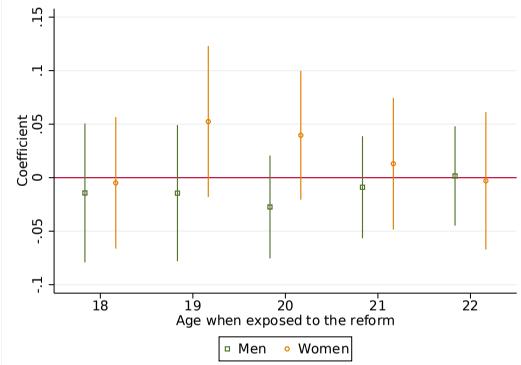
(a) Nursing and engineering: Formal participation in the labour force (early income above 187 000 nok)



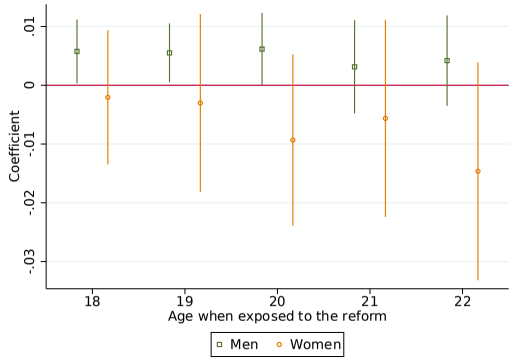
(b) Nursing and engineering: Equivalent full-time salary (yearly income above 467 500 nok)



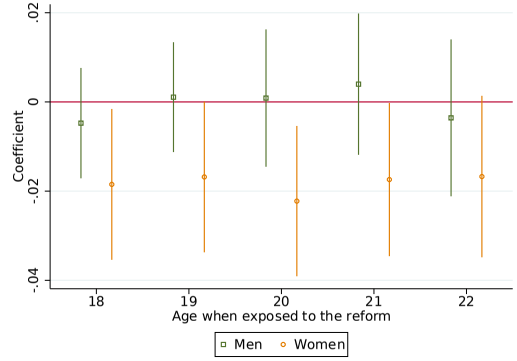
(c) Nursing and engineering: L of income



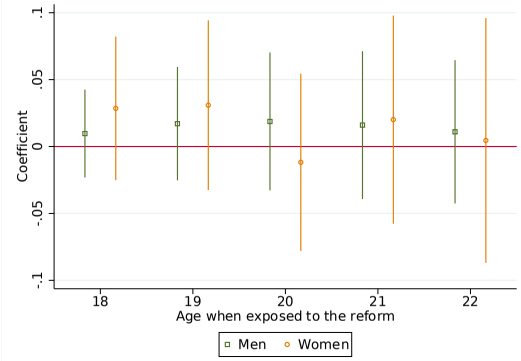
(d) Business: Formal participation in the labour force (early income above 187 000 nok)



(e) Business: Equivalent full-time salary (yearly income above 467 500 nok)



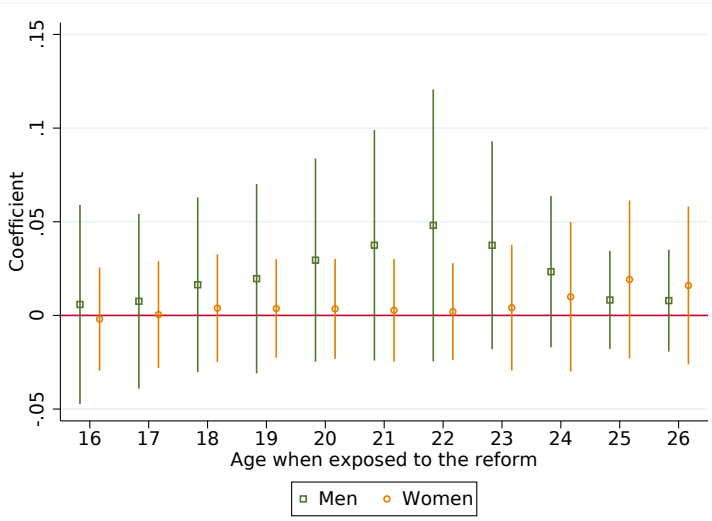
(f) Business: L of income



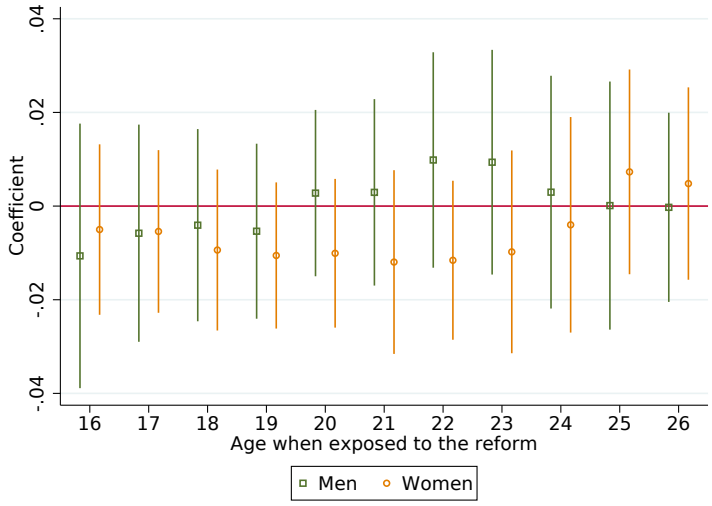
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables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

Figure C.3. 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



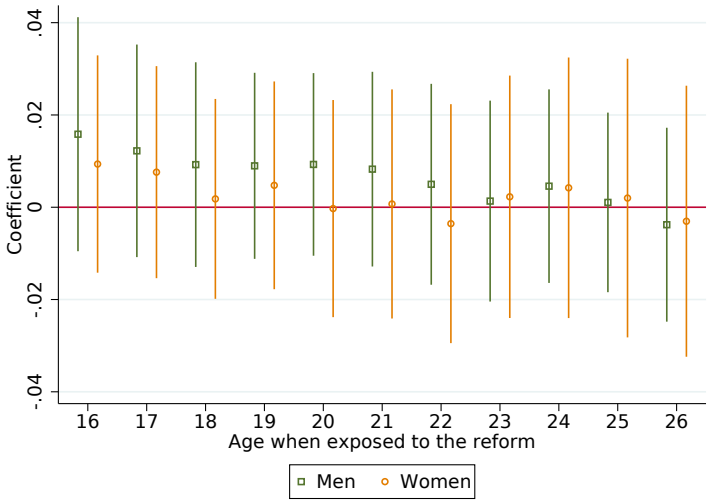
(b) Region



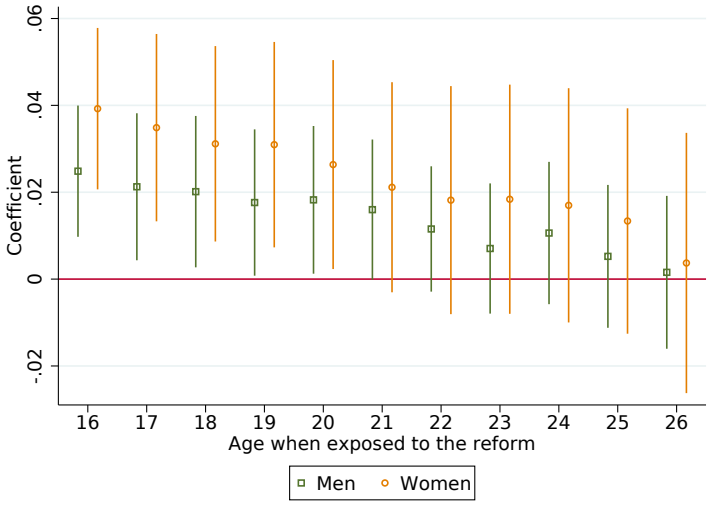
Notes: The x-axis shows the age cut-off, and each line report the point estimate and corresponding 95 percent confidence interval from comparing individuals below and above that age cut off in treated and untreated areas. Included in all specifications are municipality fixed effects, dummy variables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

Figure C.4. 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

(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 municipalites with birth year) and a constant term.Standard errors are clustered at the municpality level.

Table C.3. Professions, contingent on having a degree in business 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
Advanced engineers	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	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