# A college on every cape:

# Gender equality, gender segregation and higher educational expansion

**Adrian Farner Rogne**
Department of Sociology and Human Geography, University of Oslo

**Tora Kjærnes Knutsen**
Department of Economics, University of Oslo,
Nordic Institute for Studies of Innovation, Research and Education

**Jørgen Modalsli**
Oslo Business School, Oslo Metropolitan University

**Abstract**

The great expansion of higher educational systems in Western countries in the latter half of the 20th century had a profound impact on educational opportunities and is central to understanding the reversal of the gender gap in higher education. In Norway, major educational reforms starting in the late 1960s aimed at making higher education more accessible for large segments of the population, particularly young women who were graduating from high school at an increasing rate. This occurred through the upgrading, establishment, and gradual expansion of local and regional colleges across the country, especially in female-dominated fields associated with work in expanding public welfare sectors. Theories and previous research have suggested that the gendered profile of educational expansions contributed to the cementing of horizontal gender segregation patterns in education and the labor market. We shed light on these processes using new and detailed data on the establishment and upgrading of higher educational institutions between 1969 and 1993. Linking these data to individual-level register data allows us to study how regional variation in educational opportunities affected the educational attainment and field of study choices of young women and men, using a difference-in-differences (DiD)/event study approach. While increased access to college education was a prerequisite for the reversal of the gender gap, our findings suggest that the location of colleges mattered very little. Colleges had, at most, a very modest impact on local educational attainment and gendered field of study choices. We discuss the implications of these findings for policy and sociological theory.

**Data Availability:** The administrative register data used in this project were made available through the SEGREGATION project funded by the Research Council of Norway (RCN project 236793). These data are available from Statistics Norway to researchers with projects that satisfy the data owners' requirements. For information on how to gain access to Norwegian microdata and formal requirements, see https://www.ssb.no/en/data-til-forskning/utlan-av-data-til-forskere
Data on educational institutions has been made available online, at https://osf.io/k8t6n/

**Ethics and Consent:** The authors report no ethical issues.

**Conflict of Interest:** The authors declare that they have no conflict of interest.

**Note:** This article is one of three articles from the same project using data on educational expansions in Norway to study a range of outcomes. The other two articles focus on impacts on a) educational mobility, and b) fertility and family formation.

**Acknowledgements:** The authors especially wish to thank Rannveig Kaldager Hart and Gunn Elisabeth Birkelund for highly valuable inputs on this article, and Siri Frisli for excellent research assistance. We also owe thanks to Solveig Topstad Borgen, Nicolai Topstad Borgen, Martin Flatø, Trude Lappegård, Torkild Hovde Lyngstad, Øyvind Nicolai Wiborg, Erlend Ingridsønn Nordrum, Manne Gerell and several members of the SIPD (Social Inequalities and Population Dynamics) research group, and many other colleagues at the Department of Sociology and Human Geography and the Frisch Centre at the University of Oslo, who have offered valuable comments and insights. Also thanks to participants at the 2022 Nordic Demographic Symposium and the Norwegian Demographic Association breakfast seminar for their insightful comments, and to Geir Nygård at Statistics Norway for guidance on the coding of educations. These people bear no responsibility for any errors.

# 1 Introduction

The latter half of the 20th century was a period of major expansions of educational opportunities, particularly in industrialized Western countries (Schofer & Meyer, 2005). Norway was no exception, as this period was characterized by a massive increase in access to higher education for large segments of the population. These expansions were driven by an increasing demand for educated workers, especially in emerging industries and the healthcare, welfare and education sectors, and an increasing demand for education among growing numbers of high school graduates, especially women (Kirke- og undervisningsdepartementet, 1969b). These developments were to a large extent promoted, planned, and financed politically, and strongly intertwined with the development of the extensive Scandinavian welfare state. The reforms were in part motivated by egalitarian political ideals about equalizing educational opportunities and broadening the recruitment into higher education, meeting the growing demand for higher education among young women, regional economic, social, and cultural development, a perceived need to diversify educational opportunities, and a notion that the centralized university system left a substantial reserve of untapped talent in rural areas (Kirke- og undervisningsdepartementet, 1969b; Kyvik, 2014). These developments had major social and economic impacts on Norwegian society by enabling industrial developments and providing skilled workers for growing industries (Carneiro, Liu, & Salvanes, 2022) and the expanding health, education, and social service sectors (Birkelund & Petersen, 2016). In this article, we study if the increased availability of local college educations following these reforms contributed to the reversal of the gender gap in educational attainment, and whether they impacted gendered choices in field of study.

Before 1969, when the first regional colleges were established, Norway had approximately 17 higher educational institutions, almost exclusively located in major cities. Between 1969 and 1994, this number grew to nearly 200. In addition to the establishment of new colleges and 'institutional upgrading' of existing institutions, the student capacity at universities and colleges, both old and new, was greatly expanded. The total student capacity at higher educational institutions increased from approximately 25000 to more than 140000 students over the same period[1]. The expansion of the educational system provided easier access to higher education in the face of an increasing demand, driven in large part by a growing number of young women aspiring to attain a postsecondary education. It also coincided with the women's liberation movement and societal changes that resulted in a large influx of women into educational institutions, greater female labor market participation, the reversal of the gender gap in education, and the end of the 'housewife era' (Birkelund & Petersen, 2016).

Such aggregate trends in educational expansions, attainment and gender equality are well-documented. Less is known about the impact of college establishments and expansions locally. The reforms entailed a turn away from a centralized higher educational system dominated by a handful of universities and a myriad of local vocationally oriented post-secondary, non-tertiary institutions, towards a decentralized higher education system with a large number of local and regional colleges. In this paper, we study to what extent improved local access to college educations contributed to increasing gender equality in educational attainment, using new and detailed data on college availability. Further, despite a rapid increase in female educational attainment, the educational system and labor market remains characterized by strong horizontal gender segregation (Reisel, Skorge, & Uvaag, 2019) – a characteristic that has been dubbed 'the gender equality paradox' (see for instance (Birkelund & Petersen, 2005). We therefore investigate how fields of study offered at local institutions affected men and women's choice of field. In doing this, we discuss whether horizontal gender segregation by field of study can in part be explained by the fact that expansions of the higher education system in this period primarily occurred in traditionally female-dominated fields.

Prior studies of these educational reforms have provided valuable insights into the impact of local college availability on technological change (Carneiro et al., 2022) and gendered choices of field (Knutsen, Modalsli, & Rønning, 2022), but have been limited in scope with regards to institutional-level data. Carneiro et al. (2022) used data on 15 institutions and their student capacity, while Knutsen et al. (2022) based their analysis on 33 institutions. A strength of our study is that our data include a much wider array of institutions, enabling us to provide estimates based on more clearly defined treatment and control groups than previous studies, as we are able to identify already-treated regions with more accuracy and apply methods that handle

[1] Authors' calculations based on Frisli and Rogne (2023a).

biases due to comparisons with such regions, while simultaneously being able to differentiate between college openings due to new and upgraded educational institutions.

There are two distinct ways of framing the contribution of the present study. First, it has historical relevance as a particular case, in that it provides a deeper understanding of an important process that contributed to shaping patterns of gender equality and gender segregation in Norway; one of the most gender egalitarian societies in the world (United Nations Development Programme, 2022). As an historical case study, our results can be read as an evaluation of the impact of these major educational reforms on gender equality and gender segregation.

Second, it carries more general relevance, beyond the particular case of Norway. It is both a contribution to understanding how similar educational expansions may have impacted gender equality and gender segregation in other national contexts, understanding how female emancipation processes are affected by institutional change, and how local college opportunities affect gendered field of study choices, which still today create marked gender segregation in education. In this way, our study has implications for educational policy, as we discuss below, both in developed contexts where the geographic location of educational opportunities remains contested, and in developing contexts currently in the process of making higher education more accessible to larger segments of the population, particularly women.

Our results suggest that the opening of local colleges and the upgrading of post-secondary, non-tertiary institutions had a very limited impact on educational attainment among women, none among men, and that the fields of study offered locally did not impact on field of study choices.

# 2 Background

## 2.1 The reversal of the gender gap

The shift towards gender equality, and, eventually, female dominance in the education system was rapid during the 1970s and 1980s – at least with regard to the student composition. In 1975, women for the first time made up the majority of high school graduates. By 1981, the majority of college students were female[2], and by 1988 the same was true for university students (Birkelund & Petersen, 2016; Statistics Norway, n.d.-a, n.d.-b). Similar trends have been reported from other contexts (see for instance Buchmann, DiPrete, & McDaniel, 2008). Among men and women born in 1945, who would mostly attain their postsecondary education in the late 1960s, 25 % of men and 21 % of women attained some form of university or college education. Among those born in 1975, only 30 years later, these figures had grown to 39 % and 53 %, respectively. With these aggregate trends as a backdrop, we expect that increases in the local availability of higher education contributed to reducing and reversing the gender gap in higher educational attainment by having a stronger impact on the educational attainment of women than men. Essentially, we expect to find that women were more responsive to changes in the local access to higher education than men in this period. However, this may have occurred in ways that cemented horizontal gender segregation patterns in educational choices. In the remainder of this section, we first describe patterns of gender segregation in educational choice, with particular emphasis on the Nordic context. We then turn to theories that can shed light on why these patterns persist, emphasizing institutional and labor market expansions, normative changes, and structural explanations.

## 2.2 Gender segregation in educational choice – a Nordic paradox?

Gender segregation in education and work has persisted despite major advancements in female educational attainment and labor force participation (Charles & Bradley, 2009; Hermansen & Penner, 2022). Specifically for education, there was a trend towards reduced segregation in the late 1970s and early 1980s in Norway, but this trend stalled towards the late 1980s (Seehuus & Reisel, 2017). For long, these segregation patterns

[2] This coincided with a reorganizing and reclassification of several vocational nursing schools into nursing colleges.

were believed to be stronger in Scandinavian welfare states and more advanced economies than in many other contexts; countries with higher female labor force participation and educational attainment also tend to have stronger gender segregation patterns. This observation has been coined the 'gender equality paradox' (Birkelund & Petersen, 2005). More recently, it has been shown that gendered labor market segregation in egalitarian contexts is driven by a smaller share of women outside the labor force. In such contexts, a higher share of women are formally employed in female-dominated care work, as this work is to a lesser extent relegated to the family and informal sector. Lower labor market participation in less egalitarian contexts also results in stronger selection and less gender-normative choices among employed women. Thus, gender segregation in egalitarian contexts is not as strong in a comparative perspective as initially thought (Barth, Hardoy, Schøne, & Østbakken, 2014; Barth, Reisel, & Østbakken, 2023). A similar mechanism may apply to analyses of educational choices. In countries and historical contexts with lower female educational attainment, those women who do attain a higher education may be a more selective group, more willing to break with gendered norms both in terms of attainment and field of study. Meanwhile, contexts of mass education may be characterized by weaker selection into education on traits associated with making gender-incongruent choices; a mechanism that may to some extent counteract the effects of weakening gender norms on horizontal educational choices. Such a mechanism would be in line with the observation that individuals from lower socioeconomic origins, who are, on average, less likely to attain higher education when opportunities are more limited, also tend to make educational choices more in line with traditional gender stereotypes (Seehuus & Reisel, 2017).

Regardless of whether gender segregation is stronger in more egalitarian contexts, clear gender segregation patterns in education and work have persisted despite high and increasing female educational attainment and labor force participation. Several interrelated and partly overlapping explanations for this have been suggested in the sociological, economic, and psychological research literature (see for instance Birkelund & Petersen, 2005, 2016; Buchmann et al., 2008; Gerber & Cheung, 2008; Jacobs, 1995 for more extensive discussions). These can roughly be divided into explanations focusing on historical developments such as changes in the labor market and educational system, those focusing on gendered norms and preferences, and those focusing on obstacles and structural barriers.

## 2.3 Institutional and labor market expansions

This explanation is the one most directly relevant to our study. It is centered around the expansion of the higher educational system and specific sectors of the labor market, and how these occurred in a fashion that reinforced gender segregation patterns due to a gender-biased supply of educational opportunities and jobs during a critical historical period (Birkelund & Petersen, 2005; Charles & Bradley, 2009). Increasing female educational attainment and labor market participation in the 60s and onwards coincided with the expansion of primarily stereotypically female-gendered welfare state services and jobs (nursing/healthcare, welfare, childcare etc.), and an expansion of educational opportunities in traditionally female-gendered fields. Many traditionally female-labelled domestic tasks such as care work were moved from the private sphere into the labor market and welfare state. Thus, the educations and jobs available to the large number of women entering the labor market were primarily in traditionally female-gendered fields (Birkelund & Petersen, 2005; Charles & Bradley, 2009), which reinforced segregation patterns and cemented these fields as stereotypically female. While old gender roles as breadwinner husband and homemaker wife were being left behind, this historical process allegedly established and reinforced new gender roles and gendered divisions in education and the labor market that have since persisted (Barth et al., 2014).

While initially convincing, this argument suggests that the emergence and cementing of horizontal gender segregation patterns in education was in part driven by the increased supply of educations in stereotypically female-gendered fields. It also implicitly seems to suggest that *if* the expansion of the higher educational system in this period primarily had occurred in less stereotypically female-dominated fields, such as engineering etc., many young women would have chosen such educations instead, resulting in weaker horizontal segregation. In this article, we explore this proposition further.

Many of the new and expanding educational institutions that accommodated the increasing share of female students offered educations in primarily female-dominated fields, such as nursing/healthcare and social work. Many also offered educations in fields where the share of women grew rapidly, such as business

administration, humanities, and the social sciences. But the growth in student capacity and number of institutions in this period was far from exclusively in female-dominated fields or fields with a substantial share of women. Many new and expanding institutions offered educations in fields that remained persistently male-dominated, such as engineering, despite the coinciding increase in both the supply of such educations and in the female demand for education. Focusing on the role of gendered institutional expansions allows us to explore whether men and women responded differently to local college expansions in stereotypically male and female gendered educations. Thus, we may investigate whether the structural constraints of local educational supply had a major impact on young people's educational choices in this period, or whether gendered educational choices were unaffected by local educational opportunities, as we should expect if gendered norms and preferences for field of study prevailed.

## 2.4 Norms and preferences

While the nature of educational expansions may have contributed to horizontal gender segregation in education, norms and preferences have undoubtedly played a key role, and may explain why gender segregation patterns persist.

Societal norms surrounding gender roles and stereotypes are pervasive but did also change dramatically in the period studied here. Social norms may dictate what educational options are seen as acceptable and respectable to young men and women (England, 2010), and may operate through a variety of mechanisms, ranging from direct social control, to popular culture and role model influence. Gendered norms may also be prohibitive in the sense that they may fully exclude some educational choices as viable options because they are incongruent with gendered stereotypes. Thus, gender norms may both serve as a form of external control, but may also affect individual preferences for educations and jobs.

The economic literature on this topic has largely focused on individuals' preferences for the pecuniary and non-pecuniary attributes of potential jobs as important determinants of gendered educational choices, including wages, working hours, flexibility, future career opportunities/expected wage growth and job security. Wiswall and Zafar (2018) argue that women, on average, have a stronger preference for work flexibility and job stability, while men have a stronger preference for wages and wage growth[3]. In another study, Zafar (2013) found pecuniary factors to matter only for men's choices of major. Enjoying the coursework and work at available jobs, and the approval of friends and family, was important for choices among both men and women. Such studies are valuable for elucidating what characteristics of jobs are valued by men and women. But they frequently fall short with regards to identifying the importance of the specific and gendered qualitative aspects of work, and what individuals want to do in their jobs. Doing healthcare work as a nurse is very different from doing accounting or clerical work. Such job characteristics are not accounted for by only considering generic job aspects such as flexibility or job security, and preferences for one type of job over the other is likely strongly affected by individual personality traits, proclivities, values, and informal skills strongly related to gender[4].

England (2010) emphasizes the role of both gendered norms and pecuniary factors in shaping segregation patterns. She suggests that women will tend to seek upwards social mobility through their educational choices but will prefer to do so through choices that are in line with gendered norms. Women in general will choose gender-incongruent educations only if there are no good alternative routes to social advancement that are in line with gendered norms and will do so primarily in fields with more modest gender imbalances. Men, on the other hand, are mostly unwilling to cross normative gender boundaries, even if that would entail better educational and labor market opportunities. Such asymmetrical integration trends, where women gradually enter male-dominated fields, but men avoid female dominated fields, are a

[3] This factor may lead men to take relatively less education if the expected returns to stereotypically male educations are reduced.

[4] For instance, Zafar (2013) did not discuss gender norms or preferences for the qualitative aspects of jobs as potential explanations for gendered preferences, but a reasonable alternative interpretation of these findings could be that such motivations are strongly related to both individual, gendered preferences (enjoyment of work) and societal norms (approval from friends and family).

recurring finding in studies of this topic (see for instance Jacobs, 1995). While consistent with many developments in this period, this argument does not fully account for why some male-dominated fields, such as engineering, attracted so few women in spite of their high economic returns (Gerber & Cheung, 2008), while others, such as business administration, attracted many more, despite both being highly gendered in the mid-1900s. In this regard, gendered non-pecuniary job preferences may play a more important role. Others have pointed to similar mechanisms as England (2010), but suggested that job preferences may also be innate and have a biological origin (Gottfredson, 2002). While preferences may be in part innate and may account for some persistence in segregation patterns, social and normative change is undoubtedly a major factor in accounting for changes in gendered segregation and women's educational attainment over the 20th century. Moreover, Herd et al. (2019) have used US genetic data to show how increased educational attainment among women was linked to the loosening of gendered constraints. A recent experimental study from Norway also indicated that men may be willing to choose gender-incongruent fields if these would pay better (Seehuus, 2021), suggesting that males' aversion to stereotypically female-typed educations may be less rigid than often assumed in the sociological literature. In this study, we cannot distinguish between different sources of gendered educational preferences or proclivities, but the role of norms and preferences is still central to our discussion. Our assumption is that if gendered norms and preferences for fields of study mostly persisted throughout the period, the fields of study offered at local colleges should matter very little for gendered field of study choices.

### 2.5 Obstacles and structural barriers

A third group of explanations emphasize different types of obstacles that men and women face, that may present them with different opportunities or lead them to make different educational choices (Gerber & Cheung, 2008). Such explanations include masculine cultures, discrimination, invisible barriers, unequal allocation of family resources to young boys and girls, and the role of family formation patterns and childbearing (Birkelund & Petersen, 2005). Additionally, some have pointed to differences in competences and affinities, especially reading and math skills, possibly in the form of comparative advantages, as important for field of study choices (Breda & Napp, 2019).

Such obstacles have undoubtedly played a central role in limiting educational options for women. However, the period and process studied here was also central to the dismantling of many such obstacles, contributing to the reversal of the gender gap in education. While such obstacles are clearly central, particularly in explaining historical gender differences, this article is primarily concerned with the effects of reducing and removing one such obstacle, by way of making college educations more broadly available.

## 3 Empirical evidence on college expansions

Empirical studies of the impact of college expansion reforms have produced mixed findings. One study from Italy (Rizzica, 2013) found expansions in educational supply in 2001 to have large effects on female enrollments, but not among males, who merely shifted their enrollments to local institutions. Using a design similar to ours, Caner, Demirel, and Okten (2019) found close to opposite patterns in Turkey. Here, higher educational expansions increased the gender gap in education due to more slots becoming available primarily in social sciences (benefitting both men and women) and engineering (benefitting primarily men), suggesting an important role of gender-congruent educational choices and gender-biased educational expansions. In a recent US study, Russell, Yu, and Andrews (2021) found local college establishments to have substantial long-run impacts on local educational attainment, but they did not consider gender differences specifically. Bonander, Jakobsson, Podestà, and Svensson (2016) found no effects of research university status on the number of students in Swedish regions.

In another recent study, focusing on roughly the same period and expansion reforms as we do, Knutsen et al. (2022) found gendered choices of field to be largely insensitive to local educational opportunities in gender-incongruent fields. Men were mostly unaffected by the establishment of local educational institutions that offered stereotypically female-gendered educations and vice versa. These authors also

found that the establishment of local colleges had little to no impact on overall educational attainment, only on the choice of field. For instance, local nursing colleges increased women's likelihood of becoming nurses, and reduced their likelihood of becoming teachers, but had no impact on women's likelihood of becoming engineers or males' likelihood of becoming nurses. Another study from Norway, focusing on a more recent time period, found that the location of teacher educations matters little for regional recruitment of teachers beyond the elementary school level (Falch, 2022), suggesting a limited role of decentralized educations on educational choices, though it did not focus specifically on gender.

Our main hypotheses are, first, that local educational institutions had a substantial impact on the educational attainment of young men and women whose local educational opportunities increased. We note that there may also have been substantial gender differences. If women in this era were less (more) geographically mobile then men with regards to studying, they may have been more (less) affected by the local educational opportunities. Second, in line with the findings by Knutsen et al. (2022), we expect that increased supply of traditionally male-gendered fields of study did not result in substantially higher female take-up of such educations and vice versa. Rather, we believe that gendered norms, preferences, and gender roles, whatever their origins, prevailed in educational choices regardless of the local educational opportunities, resulting in local educational opportunities only having an impact on educational attainment in gender-congruent fields of study.

# 4 The expanding higher educational system

During the first couple of decades following World War 2, the number of high school graduates[5] grew rapidly following several reforms and expansions in the secondary educational system in Norway. This was accompanied by a growing concern that the current higher educational system would not be able to meet the increasing demand for higher education among future cohorts of high school graduates, particularly women, nor the increasing demand for educated workers, particularly in the expanding health, welfare and education sectors. Additionally, there was a widespread perception among policymakers that a diversification of the educational system was necessary, both in terms of subjects taught and in terms of the length of educations (Kirke- og undervisningsdepartementet, 1969b; Kyvik, 2014). Before 1969, the number of universities and college institutions institutions in Norway was low, and these were primarily concentrated in major cities; Oslo, Bergen Trondheim and Tromsø. The geographic distribution of universities and colleges in and around major cities meant that access to higher education was both highly geographically and socially skewed. Policymakers were concerned that without major reforms, many talented young high school graduates might not have the opportunity to attend college, while making higher education more available would be beneficial both culturally, socially, and as a means to promote economic development (Kirke- og undervisningsdepartementet, 1969b; Kyvik, 2014).

One of the responses to these challenges was the establishment of the 'Ottosen committee' in 1965. This government-appointed committee was tasked with assessing how the higher educational system should be expanded and reformed. It produced several white papers, reports and proposals that had major impacts on education policies in the years to come (Kirke- og undervisningsdepartementet, 1966, 1967, 1968, 1969a, 1969b, 1970, 1973). The most important outcome of this committee's work was the decision to establish 15 'district colleges' - primarily in regions that previously did not have any major higher educational institutions. The first three district colleges were established in 1969 in Kristiansand, Molde and Stavanger, and the final district college, in Harstad, was established in 1986. After the initial establishment, each of these institutions expanded rapidly over the first few years of their existence. Although each college was primarily specialized in specific fields, most offered a diverse portfolio of educations. For instance, Agder Distriktshøgskole in Kristiansand opened with approximately 50 students in business administration in 1969. By 1975, it also provided courses in mathematics, chemistry and other natural sciences, public

[5] Technically, 'high school graduates' ('artianere') here refers to individuals who have completed 'examen artium' – an academically oriented secondary education exam that was a qualification for most higher educational institutions (and some vocational post-secondary institutions – see below).

administration, shipping, English, electronic data processing and translation, to a total of 925 students (Agder Distriktshøgskole, 1979).

Another important development in this period was the expansion and reorganization of vocational postsecondary education. In the 1960s, there were many educational institutions that did not qualify as colleges or universities, but offered short, vocationally oriented courses and post-secondary educations in a variety of fields. These were mostly considered post-secondary, non-tertiary educations, though we are hard pressed to provide a precise definition of the educations offered at these institutions, as different contemporary sources use somewhat different definitions. They were also highly heterogenous, ranging from educations in housekeeping ('husstell') and crafts to military schools. Some offered educations similar to what would later be considered college educations (2-3 years). One source (Kirke- og undervisningsdepartementet, 1967: 29) counts a total of 662 such post-secondary educational institutions outside of the university/college system in 1967. An unspecified number of such schools (that accommodated 8 500 out of a total of 72 816 students in post-secondary non-tertiary educations) had similar admission requirements as universities and colleges, such as high school graduation.

During the 1970s and later, many such institutions were reclassified, reorganized and/or merged into colleges. This especially pertains to several teacher schools (1973/1975), social worker schools (1975), technical (engineering) schools (1976/1977), art, music and dance schools (1978) and maritime and nursing schools (1980-82) that received college status and were absorbed into the national higher education system. As part of this process, the educations and curriculums were also subject to a standardization process, and high school education became a prerequisite for admission (Frisli & Rogne, 2023b; Smeby & Terum, n.a.; Terum & Smeby, 2014). In addition to this process came the establishment and expansion of new, specialized and vocationally oriented colleges outside of the university and district college system, and several institutional mergers that included both universities, district colleges, other types of colleges and other types of vocational post-secondary institutions. The continuing growth in the number of institutions into the early 1980s was in part driven by a continued political pressure for decentralization, coupled with local initiatives for establishing new or 'upgrading' existing institutions to colleges. In several instances, this was pushed through by parliamentary decision, in spite of government recommendations (Kyvik, 2014). The growth finally decelerated towards the end of the 1980s, as it became evident that the large number of small institutions was unsustainable. The following years saw a series of institutional mergers, culminating in a major reform in 1994 where 98 institutions were merged into 26 (Kyvik, 2014), marking the end of the expansion era in terms of the number of institutions.

As is clear from this description, the expansion of higher education in Norway was the result of a combination of several types of reforms, institutional types, establishments and mergers. It is not easy to give a simplified overview of these processes. However, as we describe below, we have made effort to gather, classify and document the expansion of the higher educational system over this period. In panel a of **Figure 1**, we show, based on our own data on institutions that at some point became classified as higher educational institutions, how the educational system expanded between 1965 and 1992[6], in terms of the number and types of institutions. As can be seen, before 1969, when the first district colleges were established, there were approximately 17 university/college institutions in Norway, but in the early 1990s this number had grown to just below 200[7]. These developments were the result of a combination of the establishment of new- and the upgrading of existing institutions.

Although there are limitations to these data, as described below, and records for some institutions are incomplete, we believe they provide a good foundation for studying the impacts of the educational expansions of this period. Figure 1 also shows the proportion of each birth cohort (1950 to 1974) attaining a tertiary education (panel b), separately by sex. This graph clearly shows how the educational attainment of women born after WW2 increased rapidly, and the proportion attaining higher education continued to increase throughout the period, while the corresponding trend for men was weaker, and stagnated for cohorts born in the 1950s.

[6] Data quality after 1992 is less good.

[7] 6 colleges are classified as post-secondary, non-tertiary institutions towards the end of the period due to missing information on the timing of institutional upgrading.

*[Figure 1]*

# 5 Data

In this article, we use two main data sources. The first is institutional-level data on college expansions. The second is population-wide individual-level administrative register data and census data, provided by Statistics Norway. These sources are linked by municipality codes, and each is described below.

## 5.1 College data

We use a brand-new data set on college expansions (Frisli & Rogne, 2023a). The data set, along with detailed documentation (Frisli & Rogne, 2023b) is available online. The primary sources of these data are state budgets, made available through the digital archives of the National Library of Norway (nb.no), although these are supplemented with information from other sources where relevant. All data sources are provided in the data set, with URLs for those that are available online. Our data set contains information on 202 higher educational institutions, with information on specific faculties, sub-units or coarsely grouped fields of study also included separately for some larger institutions (especially universities and university colleges). The information on these institutions includes name, municipality of location, the year of establishment, the year the institution was first considered a university or college institution, and the field(s) of study offered at the institution. It also includes information on the student capacity at each institution.

We primarily rely on data on the establishment year of colleges and institutions that would later receive college status. In the individual-level education register (described below), educations taken at institutions that would later receive college status are registered as higher educations, even if they were completed before the institution received college status. Our register data only allows us to distinguish between college educations and educations taken at institutions that would later receive college status completed from the year 1970 onwards. However, we can use information on the length of educations to assess the impacts of institutional upgrading. We therefore run separate analyses for these outcomes. In one approach, we study the impact of *new educational institutions* in a limited number of regions that previously had none, on higher educational attainment. In the other approach, we study the impact of *institutional upgrading and new college institutions* on length of educations in regions that previously had post-secondary, non-tertiary institutions. Unfortunately, the data on college capacity, which would provide a more accurate measure of the availability of college educations is incomplete in the years prior to institutions receiving college status, since these were not included in national budgets.

## 5.2 Administrative register data

Our population-wide administrative register data is drawn from the population registers and education register. Our sample covers the full birth cohorts 1950 to 1974, and in this article, we use data on municipality of residence, sex, birth year, highest recorded educational attainment by level, length and field, each parents' educational attainment[8] and birth year, and family files documenting family relationships that we use to link parents and children and construct a variable for maternal birth order. In addition, we use some variables to impose sample restrictions. Specifically, we use register status, immigration and emigration dates etc. to exclude individuals who were dead, emigrated, or not yet immigrated at age 17. Register information on municipality of residence was available from 1968, the year before the first reforms we study.

[8] Parents educational attainment is used based on the year when the individual was aged 16 on January 1st. For years before 1970, we use information from 1970. For years between 1970 and 1980, we use information from 1980.

# 6 Methods

## 6.1 Data preparation and sample restrictions

Our main analyses are based on economic regions, using the earliest available standard, from 2002, produced by Statistics Norway. These represent medium-sized geographical areas, consisting of several neighboring municipalities within commuting distance, that are considered to represent local labor markets with regional centers, and correspond to the NUTS 4-level in EU's regional classification (Statistics Norway, 2002). By basing our analysis on economic regions, we intend to capture the impact of changes in the availability of colleges within commuting distances in local regions. This is also in line with the approach taken by Knutsen et al. (2022), who obtained similar results using both economic regions and self-defined commuting regions. Using the 2002 standard, we have made some minor adjustments to account for changes in the municipality structure, resulting in 89 regions that are stable geographical units over time. Analyses based on an alternative coding of regions, using larger units, as described by Knutsen et al. (2022) yield substantively similar results and are not included.

Norway also has two official subnational geographic units – the county level and the municipality level. In the period studied here, Norway was divided into 19 counties[9]. We consider counties to mostly be too large to reflect 'local' educational opportunities, and do not consider these further here. We do, however, provide estimates based on municipalities as robustness checks in the supplementary material.

Note that both economic regions and municipalities represent plausible geographic units of analysis. On the one hand, it is reasonable to assume that individuals' propensity to attain a college education is affected by the student capacity in their municipality. But individuals are also likely to respond similarly to student capacity changes in neighboring municipalities. Such spillover effects are likely to be smaller at the regional level.

While the individuals in our analyses are those directly affected by college expansions, we also include information on their parents[10]. For each year in our observation window, we sample the entire population that was registered as resident in Norway and were aged 17 years old on January 1st. This age was chosen because 17-year-olds are unlikely to have started college education, and because they are also unlikely to have moved in response to college availability (in anticipation of starting a college education). We use their municipality of residence at this point in time to link them to present and future college availability data. We use one observation per individual, and restrict our observation window to the years 1968 to 1992. Thus, our focal individuals were born in the years 1950 to 1974. Since we only use one observation per individual, controls for calendar year also capture birth cohort effects.

Detailed information on educational attainment is available from 1970, and annually updated from 1980 onwards. Thus, we do not have annually updated information on educational attainment before 1970 or 1971-1979. However, since educational attainment is coded as the individuals' highest registered level, change over time for each individual is unidirectional (people cannot lose an educational level). We therefore use the highest educational level recorded in the registers as our indicator of educational attainment. In addition, since institutional upgrading resulted in many 2-year vocational educations being upgraded to 3-year college educations, this may affect length of education, without affecting the educational level, as it is recorded in the registers. Numbers of years of education in the registers do, however, reflect the standard length of educations taken regardless of whether it was formally classified as a higher educational institution. We therefore include a variable indicating the number of years of education in one of our analyses, based on the NUS2000 standard from Statistics Norway[11].

[9] To be precise, Norway had 20 counties until 1972, when the county of Bergen was merged with the county of Hordaland..

[10] Note that in practice, two generations of the same family may be included in our analyses. An individual may be affected by college expansions in 1969, have a child in 1971, and that child may be affected by college expansions in the late 1980s and early 1990s.

[11] Thanks to Geir Nygård at Statistics Norway for this suggestion.

We include all individuals, regardless of whether they are high school graduates. In theory, graduating from high school is a prerequisite for entering college, and college expansions were intended to affect high school graduates (Kirke- og undervisningsdepartementet, 1966). In practice there were exceptions to this rule[12]. Restricting our sample to individuals with a high school education would also be endogenous to both gender and family background variables (Elwert & Winship, 2014) and would lead to biased estimates of gender differences. If adolescents responded to local colleges by attending high school to a greater extent, such a sample restriction would also bias our estimates. The composition of high school graduates also changed considerably over the period, as high school graduation gradually became less selective. For methodological reasons outlined below, we also exclude areas that had higher educational institutions before 1969 in our TWFE models. Such always-treated units are automatically excluded from event study models.

## 6.2 Variables

Our main explanatory variable of interest is the local college availability, measured by a dummy variable which takes the value 1 if there is a college in the region in the given year, and zero otherwise. In our analyses, we sample individuals at age 17, but have opted to focus on the college opportunities individuals would face at age 20 (representing a lead of three years). Thus, our main independent is based on the region individuals reside in at age 17 (or municipality in supplementary analyses) but indicates whether there is a college in that region when the individual is aged 20, assuming that they do not relocate. This lead is meant to safeguard against biases due to endogenous moves while capturing the college availability at the age where college entry was most common. For some analyses, we are particularly interested in the availability of colleges offering educations in a specific field of study. In these cases, we use a similar indicator specific to each field of study.

While we mainly focus on college availability at age 20, we also present results based on the local college availability at ages 18, 20, 22 and 24, since prospective students may be affected by the college availability at other ages. In Norway, it is quite common to take one or more years off from education after high school graduation, before returning to studies (Raabe, 2002). Additionally, men in this period were subject to mandatory military (or civil) service (Nåvik, 1997), which would also postpone their education. The limited data we have on the age composition of students at colleges in this period suggests that most students were aged between 18 and 25, and that female students on average started earlier than male students.[13]

We include individual level and background variables related to the family background/social origins of the focal individuals. These include the father's and mother's educational level (9 categories each, plus a category for missing cases)[14], maternal birth order[15], the age of each parent and the population size of the municipality that the focal individual resides in at age 17, and sex. In addition, all models include controls for geographic units (regions, or municipalities in supplementary analyses) and year (referring to the year when the focal individual is 17).

---

[12] For instance, Brattvåg and Carlsson (1981: 3) report that 6.4 % of new students at 'district colleges' had not completed a 3-year high school education, with substantial variation between colleges; 34.6 % at Nordland Distriktshøgskole.

[13] Brattvåg (1975a) reports that the vast majority (69.3 %) of new district college students were aged between 20 and 25 in 1973, with an additional 11.7 % who were younger. Similar figures have been reported for later years (Brattvåg, 1975b, 1976, 1977, 1978; Brattvåg & Carlsson, 1981) with a modal age around 20-21, and a younger age distribution among women than men. Our register data also reveal that among students at higher educational institutions between 1974 and 1993 (regardless of whether they were recently enrolled), 69 % were aged between 17 and 25 (not shown).

[14] In a very few cases, focal individuals have same-sex parents. In these cases, we use the educational level of the oldest parent. Where possible, we use information on parent's educational level in the year the focal individual is 16 years old on January 1st, to avoid using information on educations attained after the focal individual could enter college. The registers do not contain information on educational levels before 1970 or for 1971-1979. In the years before 1970, we use data from 1970. In the years 1971-1979, we use information from 1980. Our reasoning is that the educational levels of young parents would be too low if we had used information from 1970 for subsequent years.

[15] We only include maternal birth order, as maternal birth order is more important for educational outcomes than paternal birth order (Lillehagen & Isungset, 2020), and because we have some cases of missing paternal birth order information.

The socioeconomic variables are included both as control variables, and to be used in balance tests to check whether the establishment of colleges was systematically related to characteristics of the local population. As mentioned above, the location and timing of college openings and expansions was not random; it occurred primarily in regional centers, where the population was on average more highly educated, and the timing may have been related to characteristics of the local high school cohorts, even net of geographical and time fixed effects. Maternal birth order is included as this is an important source of within-family variation in educational attainment that may be a relevant confounder as later-borns will often be exposed to better educational opportunities locally.

We study several outcome variables. Educational attainment levels are based on the first digit NUS codes (Statistics Norway, 2014). Years of education are based on the NUS2000 standard. Field of education is based on second and third digit NUS codes. Due to the relatively coarse coding of fields of study at local colleges, we have regrouped NUS codes for field of study in our register data to correspond with the coding of fields of study in our college data (see Supplementary material S1 for the coding scheme).

## 6.3 Statistical models

### Modelling strategies

We have opted to use two different modelling strategies – a two-way fixed effects (TWFE) regression, and an event study design.

Our research design can be seen as a Difference-in-Differences (DiD) design with multiple treatment groups and time periods and a dichotomous treatment variable, with stayers and variation in the timing of first treatment, where treatment effects are likely to be dynamic and heterogeneous. The standard approach for handling analyses similar to ours is to employ a linear probability model with TWFE, where the outcome is regressed on the treatment dummy, and dummies for discrete time and treatment group indicators.

In practice, using the TWFE approach entails estimating a coefficient that represents a weighted average of all pairwise difference-in differences in the data, where the weight is given by the number of observations and the variation within each geographical unit, meaning that larger weights are given to larger geographical units, and units where changes in treatment status occur near the middle of the observation period (Goodman-Bacon, 2021). This also means that, in addition to being based on a comparison of treated to untreated units, it is also based on a comparison of treated to previously treated units. Such comparisons with previously treated units may be a source of bias.

We also perform an event study analysis. The recent literature on DiD methodology has resulted in several new estimators and related software developed to estimate treatment effects in cases that deviate from the classical 2x2 DiD design (De Chaisemartin & D'Haultfoeuille, 2022; De Chaisemartin, D'Haultfoeuille, Pasquier, & Vazquez-Bare, 2022). We have opted to use event study models, based on the did_multiplegt package in Stata (de Chaisemartin, D'Haultfoeuille, & Guyonvarch, 2019), as this setup is able to handle multiple treatment groups, multiple time periods, variation in treatment timing, and dynamic, heterogeneous treatment effects. This approach was chosen since, due to differences in the size, growth over time and characteristics of colleges, and differences in the characteristics of the local population, treatment effects are likely both dynamic and heterogeneous.

### Two-way fixed effects (TWFE)

In our setup, when including control variables, our TWFE models can be expressed as:

$$1) \quad p(HE)_{i,age} = \alpha + \beta_1 \times C_{gt,age} + \boldsymbol{\beta_2} \times \boldsymbol{G_g} + \boldsymbol{\beta_3} \times \boldsymbol{Y_t} + \boldsymbol{\beta_4} \times \boldsymbol{X_i} + \varepsilon_{i,age}$$

In this linear probability model, $p(HE)_{i,age}$ is the probability that an individual *i*, resident in the country at age 17 attains a higher education at some point in their life course. $C_{gt,age}$ is our treatment dummy

representing the availability of local colleges in a given region and year (cohort) when the individual is aged 18, 20, 22 or 24. *G* represents a set of dummies for geographical units, *Y* represents a set of dummies for calendar years, and *X* represents control variables as presented above. *g* and *t* are indexes of geographical areas and years, respectively, while *age* indexes the age lead for the treatment variable.

We estimate our TWFE models in two different specifications. The first specification includes no control variables except geographical unit and year dummies. In the second specification, we add the control variables discussed above. Note that all TWFE models are estimated with standard errors (SE) clustered on geographic units and estimated separately by the age at which we measure the college availability (the treatment lead). To reduce the biases associated with comparing treated to previously treated units, we only include geographical units that did not have a higher educational institution before 1969. Comparisons with late-treated units remain a potential source of bias. For this reason, we treat our TWFE models as our baseline specifications, but also employ an alternative estimation strategy.

**Event study design**

The results from event study estimations are presented as event study graphs showing the effects of the treatment at different durations (cohorts), relative to the pre-treatment period (and untreated areas). The event study equation can be expressed as:

$$2) \quad y_i = \sum_{k=-4}^{10} \beta_k D_i^k + \gamma_c + \delta_r + \boldsymbol{\beta}\mathbf{X} + \varepsilon_i$$

Here, $y_i$ denotes the outcome variable of interest (higher education, field of study, or years of education), where k=-1 is the (omitted) reference category. $\gamma_c$ and $\delta_r$ denote cohort fixed effects and region fixed effects, respectively. In some specifications, we also include a set of control variables $\mathbf{X}$, as described above[16]. Coefficients $\beta_k$ for the dummy variables$D_i^k$ indicating the duration in years (cohorts) since college establishments, are our main parameters of interest. The indicator k takes the value 0 for individuals in the first treated cohort in each region, in line with convention. Other cohorts in the region have negative values if they were older than the first treated cohort at the time of college establishment, and positive values if they were younger (i.e. would reach college age later). While age 20-21 was the most common age to start a college education, there were no sharp age restrictions on admittance, meaning that older cohorts may be seen as partially treated. For individuals in regions where no college was established throughout the period, k-values are set to -1. Bootstrapped standard errors (3000 bootstraps) are clustered at the geographic unit.

We run separate models by sex, where we study the impact of the establishment of educational institutions in regions that had none, and where attaining any higher education is the outcome variable. In addition, we run models where we study the effects of institutional upgrading by restricting the sample to regions that had post-secondary, non-tertiary educational institutions, and use the establishment of a college (due to new institutions or upgrading of existing ones) as the treatment variable, and length of education as the outcome variable. These analyses include 22 regions with post-secondary, non-tertiary institutions that received one or more colleges during the period. To study choice of field, we use models where the outcome variable is the attainment of a higher education in a specific field, the treatment variable is an indicator of the establishment of educational institutions offering educations in that field, in regions that had none, while indicators of the presence of institutions offering educations in other fields are included as control variables (with no substantive impact on our results).

[16] Our main models are run in Stata using the following specifications:
did_multiplegt [outcomevar] [region] [year] [treatmentvar_age20] if sex == [male/female], breps(3000) cluster([region]) robust_dynamic dynamic(10) average_effect placebo(4) longdiff_placebo

# 7 Results

## 7.1 Descriptive statistics

In addition to descriptive information shown in figures, we display descriptive statistics for colleges and individuals in **Table 1**. We do so for selected years; 1968 (the last year before the major expansion reforms), 1980 (a mid-point in our study period), and 1992 (the last year in our observation window). As can be seen, colleges and post-secondary, non-tertiary institutions were mostly located in regions with above-average educational levels, and larger populations. Unsurprisingly, these differences mostly diminished over time with regards to colleges, as new colleges were established/upgraded in more rural regions. It is also worth noticing that differences in (eventual) educational attainment between regions with and without colleges became smaller for both sexes in the first part of the period. This is likely partly due to the location of colleges becoming less selective over time, as more rural regions received colleges. Further, colleges offering different fields of study were not established in the same periods. As mentioned above, art/dance/music/theatre colleges, economics/administration/business/hotel colleges, engineering/maritime/tech/STEM/biomedical colleges, sports/military colleges and teacher/theology colleges were almost exclusively established or upgraded in the first half of the study period, while healthcare and social work colleges were mostly established or upgraded later.

*[Table 1]*

## 7.2 Balance tests

As a balance test, we run TWFE models, separately by sex, where the treatment variable at age 20 ($C_{gt,20}$) is treated as an outcome variable. In other words, we attempt to predict the opening of educational institutions in regions with no pre-existing educational institutions (left panel), and the establishment of colleges through either the establishment of new institutions or the upgrading of existing post-secondary, non-tertiary institutions in regions where such institutions existed previously (right panel). We do so based on individual socioeconomic and family characteristics and the population in the region (in 1000s), net of regional and time fixed effects, with always-treated regions excluded. The results, as shown in **Figure 2**, with lower secondary education as the base category for education dummies. These results reveal that the opening of new institutions was mostly unrelated to these characteristics. In the left panel, only one coefficient (population size, for both males and females) was statistically different from zero. This is promising for our research design. For the establishment of colleges in regions with existing post-secondary, non-tertiary institutions, population size was unrelated to the outcome, but one and two parental education dummies are associated with institutional upgrading for males and females, respectively. We proceed with our main analyses assuming that these reforms were mostly unrelated to individual-level characteristics, but provide results including these variables as control variables in the supplementary material (see below).

*[Figure 2]*

## 7.3 Gender differences in attainment

Focusing first on gender differences in educational attainment, we begin by showing how the attainment of educational levels evolved over cohorts of women and men in this period. Including all individuals resident at age 17, for whom we have information on educational attainment, **Figure 3** shows this development over the cohorts 1946 to 1974. Here, we see the massive increase in the proportion of the population attaining a tertiary education, particularly among women. It is also worth noting how the proportion completing high school education or more grew particularly strongly among females in the earliest cohorts, compared to males[17].

*[Figure 3]*

[17] The spike in basic upper secondary educations prior to the 1960 cohort is due to an educational reform in 1974 where individuals with short educations at the basic upper secondary level were reclassified as having lower secondary educations (Geir Nygård, Statistics Norway – personal correspondence). This is not relevant to our study.

In the following, we turn our attention to analyzing how local educational expansions contributed to these developments. In particular, we ask if the establishment of local educational institutions impacted the educational attainment of women more than that of men, relative to regions where no institutions were established. Running the model presented in Equation 2 for regions, separately by sex and age, produces the results presented in **Figure 4**. Substantively, the coefficients in the left-side panel can be interpreted such that establishing one or more local colleges increases the probability that a young female will attain a higher education by around 2 percentage points, although these estimates are not statistically significant at the 5% level. We find no effect for males.

Including our control variables in the models (right-side panel) does not dramatically affect our point estimates. Among females, the coefficients are slightly larger, and significantly different from zero, but they are not very precisely estimated. Point estimates for males remain close to zero and non-significant. These estimates are substantively quite modest, considering that the baseline probability of attaining a higher education is 29 % for males and 37 % for females in this analysis sample (averaged across all years, for regions with no colleges before 1969). The gender differences do suggest that local colleges had a larger impact on the educational attainment of women. These estimates are not particularly sensitive to the age at which we measure college availability.

*[Figure 4]*

As discussed above, the TWFE estimates are likely biased by comparisons with already-treated units. To provide unbiased estimates, we employ our event study models, and we do so separately by age and sex. The full event study graph results from models without control variables are displayed in **Figure 5**. These show the effects of college establishments on the educational attainment of individuals in the affected cohorts, relative to the timing of the college establishment.

As can be seen, the estimates are mostly modest for males, suggesting that local colleges had little impact on their higher educational attainment. For females, the point estimates are somewhat higher at ages 20-24, indicating that local colleges had a moderate positive impact on their attainment of college degrees. The estimates are, however, neither statistically different from zero, nor consistently statistically different from the corresponding point estimates for males. We are therefore hesitant to draw strong conclusions about gender differences here. In sum, these results lead us to conclude that local colleges had only a small, if any, impact on the attainment of college degrees, and if so, only among young women.

*[Figure 5]*

Estimating models for the impact of institutional upgrading on years of education, we find similar results. While this analysis includes more treated regions, coefficients are generally small and non-significant, with no systematic gender differences (**Figure 6**).

*[Figure 6]*

## 7.4 Horizontal gender segregation in education

To study horizontal gender segregation patterns, it is useful to start with an overview of how these patterns developed over the period studied here. In **Figure 7** we show fields of study by birth cohort among those who obtained a higher education, separately by sex. From this figure, it is clear that the reduction in the proportion of males attaining a higher education in the 1950s cohorts was primarily driven by a reduction in the share of males studying to become teachers (or theologists). Similar, reductions, but smaller in absolute terms, can be seen for architecture/product design and odonthological/pharmacological/medical/veterinary educations; fields that have become increasingly female-dominated. Engineering/STEM educations consistently attracted a large share of males throughout the period, while humanities and social sciences, and economics/business administration grew in popularity. The growth in female educational attainment occurred across virtually all fields, particularly in humanities and social sciences, healthcare/social work and economics/business administration.

*[Figure 7]*

Turning our attention to the impact of local educational opportunities on field of study outcomes, we focus on four broad fields of education that have different gendered profiles;

- *healthcare, social work and health sciences*, which have been persistently female-dominated throughout the period,
- *engineering, maritime, studies, tech and other STEM-educations*, which have been persistently male-dominated throughout the period,
- *teacher and theology educations*, which became increasingly female-dominated, in part due to a smaller share of males choosing such educations, and
- *economics, business, administration and hotel services educations*, which became increasingly female-dominated, but where the share attaining such educations grew among both males and females

We then model the impact of local institutional establishments in specific fields on the probability that an individual will attain an education in each of these four abovementioned fields, separately by sex, using event study models. Here, attaining a college education in each specific field is the outcome variable, and the establishment of local institutions offering educations in the corresponding field, in regions that previously had no institutions offering educations in that field, is the treatment variable. We thus include regions that already had institutions offering educations in other fields, but control for the prescence of such institutions. This produces the results displayed in **Figure 8.**

*[Figure 8]*

First, we note that pre-treatment trends are not parallel for all fields of study. In particular, the pre-treatment trends for the impact of teacher and theology colleges on the attainment of teacher and theology educations are worrisome, and the results should be interpreted with caution. Second, these analyses produce effect estimates that are very small, and mostly not significantly different from zero, suggesting that local colleges had little to no impact on field of study choices. Including individual-level control variables produces almost identical results (not shown).

## 7.5 Robustness and sensitivity

While we attempt to remove potential sources of bias through our research design, there are some limitations to our analyses. The first, related to the TWFE estimator is discussed above.

The second limitation is that the location and timing of college expansions may not be as good as random. Above, we tested whether the local college capacity is systematically related to a set of observed variables. These balance tests revealed that the establishment of local colleges was mostly unrelated to characteristics of the local population, net of geographical and time fixed effects. This is the best indicator we have that our estimates are not severely biased by selective timing and location of colleges. Yet, we cannot rule out the possibility that it was related to unobserved characteristics of the local regions. For instance, given that the establishment of colleges was often campaigned for locally, it may be that individuals were more motivated in those places and time periods where they were established. Such effects are likely to produce an upward bias compared to a scenario where colleges and their capacity were randomly assigned. Our small point estimates suggest that upward bias is not likely to be a major issue.

Third, as we show below, not all pre-treatment trends are parallel. Our event study models provide a built-in test of the parallel trends assumption required for DiD-designs, and we therefore do not dedicate a separate section to these tests. The majority of our model specifications pertaining to educational attainment produce pre-treatment trends that are reasonably close to parallel, but a few do not. This is an issue that limits the value and the validity of our main findings regarding field of study choices, but we believe that our overall conclusions that the effects are minor still hold.

Fourth, we know for a fact that there is substantial spatial spillover in the impact of local colleges. While local students were clearly overrepresented in colleges, some also moved greater distances to study (Brattvåg, 1975a, 1975b, 1976, 1977, 1978; Brattvåg & Carlsson, 1981). This means that people residing in 'untreated' regions did also have access to college, just further away, meaning that rather than measuring the impact of college access vs. no college access, we measure the impact of close college access vs. more

distant college access. This is likely to bias our estimates downward, compared to a design where the treatment assignment is sharp.

We have also run our main analyses on educational attainment with several alternative model specifications (results are included in the supplementary material):

- Using municipalities rather than regions as geographical units in TWFE models both without and with control variables (S2). This yields positive point estimates for males. Only estimates for males, with controls, at ages 18 and 20 are significantly different from zero.
- Including control variables in event study models of the impact of new institutions (S3).
- Including control variables in event study models of the impact of institutional upgrading (S4).
- Using municipalities rather than regions as geographical units in event study models of the impact of new institutions (S5).
- Using municipalities rather than regions as geographical units in event study models of the impact of institutional upgrading (S6)
- Allowing for region-specific cohort trends in TWFE models (S7). This yields smaller point estimates for females.

These results are, for the most part, substantively similar to our main results, suggesting that our findings are fairly robust to various model specifications, in the sense that they consistently suggest small effects. This particularly holds for our event study models. Despite the reservations discussed in this section, we do believe that our approach substantially reduces potential sources of bias and allow us to say something meaningful about the potential size of the effects of establishment of new institutions, and the upgrading of existing institutions; at most, they are modest for women and nonexistent for men.

# 8 Discussion and conclusions

The expansion of the higher educational system in the 1960s to 1990s was an important part of the change from a centralized, exclusive higher educational system catering to a small elite to a system of local mass education. These processes did not stop in the 1990s, as the growth of the educational system has continued, particularly at higher levels. But since the early 1990s, a large number of small, local institutions have been merged in attempts at creating larger, more robust colleges and universities. The structure and location of higher educational institutions remains a contested topic, prominent in political debates in Norway and elsewhere.

Meanwhile, the gender gap in educational attainment has continued to grow, with women obtaining higher education to a larger extent than men, and important horizontal segregation patterns by field of study have persisted. While some previously male-dominated fields, such as medicine and law are now dominated by female students, other fields, including many classical STEM-fields continue to have a large, though in many cases gradually diminishing, male majority. Traditionally female-dominated fields, such as nursing and social work have not seen a gradual influx of male students of a similar magnitude (Støren & Arnesen, 2003).

In this article, we have investigated how the gradual, staggered and geographically uneven process of higher educational expansion impacted the educational choices of young women and men. We have been particularly interested in whether local access to higher education contributed to the closing and reversal of the gender gap in higher education, and whether local differences in field of study options had an impact on gendered choices of field.

Our findings were not completely in line with our expectations, or with previous research. First, we found that while local access to colleges may have had a modest and non-significant impact on educational attainment among females. This finding is in line with those of Knutsen et al. (2022), who found no effect of these expansion reforms on overall educational attainment. Although the expansion of the higher education sector was a prerequisite for the massive increase in educational attainment in this period, particularly among women, we believe that the modest effect sizes we report can be interpreted as an indication that the exact location of colleges did not have a major impact. While our research design entails

that we cannot pinpoint the effect size with great accuracy, our results do one important thing; they allow us to rule out that these effects are big. This is also in line with the results from Falch (2022), who found local teacher educations to matter little for recruitment.

Second, we found that local college availability in various educational fields had small to no impacts on field of study outcomes. All coefficients were substantively small, most were not statistically significant, and the gender differences were minor. This suggest that for most individuals, the locations of specific fields of study had limited impact on what educations they pursued.

Our results do not lend much support to the notion that gender segregation patterns in higher education resulted from, or were cemented by, the co-occurrence of increasing female educational attainment and educational expansion in traditionally female-dominated fields – at least at the local level. If local supply-side factors played an important role in shaping gender segregation patterns, we would have expected women to respond positively to local educational opportunities also in gender-incongruent fields such as engineering and other STEM-fields. Our results rather suggest that individuals to a large extent made educational choices regardless of what educations were available locally, likely because people were willing to move outside of their local regions to get the education they wanted. This does, however, leave open the possibility that the overall increase in the supply of stereotypically female educations may have played a role in cementing these segregation patterns, though not locally.

Nevertheless, our results do suggest that social norms and/or gendered preferences played a major role throughout the period. While the gender composition of economic and teacher educations shifted, nursing and STEM educations remained persistently gender segregated, and the local availability of such educations did not increase the probability of making gender-incongruent educational choices to any substantial degree. This is consistent with the notion that norms or preferences were mostly prohibitive to making strongly gender-incongruent choices.

These results also have some implications for ongoing debates on educational policy, in that they suggest a limited role of local institutions for educational choices. While local access to education may have shifted some individuals on the margins, most men and women in this period largely made such choices irrespective of what opportunities were available locally. One possible implication of this is that decentralization of education is less important than the total, aggregate student capacity in providing educational opportunities. We have not, however, investigated whether local educational institutions affected mobility patterns and the local labor markets. It is possible that local institutions are beneficial for the local recruitment of workers in specific fields, although the study by Falch (2022) suggests that this may not be the case. This is a topic for further research, where the data gathered and made available through this project may prove valuable in this regard.

Finally, we note that while the period studied here saw major reforms of the higher education system, especially in terms of the number of higher educational institutions and total student capacity, many such institutions were the result of institutional upgrading of previous vocational post-secondary, non-tertiary institutions. Educations taken at such institutions provided access to similar jobs both before and after these reforms and are registered as higher education in the educational registers. Many such institutions were female-dominated, especially the nursing and social worker schools. This entails that assessing the impact of these reforms is not quite straightforward, and more research can be done to disentangle their effects. It also entails that the reversal of the gender gap in higher education in the early 1980s, as the story is commonly told, was not the result of a sharp increase in educational attainment among women, but the result of how institutions were classified. Women had already been pursuing higher education to a greater extent than men for several years. The early 1980s was just the period when nursing schools were formally classified as colleges.

**References**


Agder Distriktshøgskole. (1979). *Agder Distriktshøgskole Kristiansand 10 år. 1969-1979. Jubileumsskrift.* Kristiansand: Agder Distriktshøgskole.

Barth, E., Hardoy, I., Schøne, P., & Østbakken, K. M. (2014). Hva betyr høy yrkesdeltakelse for kjønnssegregering? *Kjønnsdeling og etniske skiller på arbeidsmarkedet*, 108-118.

Barth, E., Reisel, L., & Østbakken, K. M. (2023). The Equality Hurdle: Resolving the Welfare State Paradox. *Work, Employment and Society*, 09500170231155293.

Birkelund, G. E., & Petersen, T. (2005). Det norske likestillingsparadokset. In I. Frønes & L. Kjølsrød (Eds.), *Det Norske Samfunn* (Vol. 5, pp. 126-153). Oslo: Gyldendal Akademisk.

Birkelund, G. E., & Petersen, T. (2016). Likestilling. Utdanning, politikk og arbeid. In I. Frønes & L. Kjølsrød (Eds.), *Det norske samfunn, bind 2* (Vol. 7, pp. 190-2010). Oslo: Gyldendal Akademisk.

Bonander, C., Jakobsson, N., Podestà, F., & Svensson, M. (2016). Universities as engines for regional growth? Using the synthetic control method to analyze the effects of research universities. *Regional Science and Urban Economics, 60*, 198-207.

Brattvåg, T. (1975a). *Søkning til og opptak ved Distriktshøgskolene 1973*. Retrieved from Agder Distriktshøgskole, EDB fagseksjon:

Brattvåg, T. (1975b). *Søkning til og opptak ved Distriktshøgskolene 1974*. Retrieved from

Brattvåg, T. (1976). *Søkning til og opptak ved Distriktshøgskolene 1975*. Retrieved from

Brattvåg, T. (1977). *Søkning til og opptak ved Distriktshøgskolene 1976*. Retrieved from

Brattvåg, T. (1978). *Søkning og opptak ved Distriktshøgskolene 1977*. Retrieved from

Brattvåg, T., & Carlsson, T.-W. (1981). *Søkning og opptak ved Distriktshøgskolene 1980*. Retrieved from

Breda, T., & Napp, C. (2019). Girls' comparative advantage in reading can largely explain the gender gap in math-related fields. *Proceedings of the National Academy of Sciences, 116*(31), 15435-15440.

Buchmann, C., DiPrete, T. A., & McDaniel, A. (2008). Gender inequalities in education. *Annu. Rev. Sociol, 34*, 319-337.

Caner, A., Demirel, M., & Okten, C. (2019). Attainment and gender equality in higher education: Evidence from a large scale expansion. *IZA Discussion Paper No. 12711*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3483949

Carneiro, P., Liu, K., & Salvanes, K. G. (2022). The supply of skill and endogenous technical change: evidence from a college expansion reform. *Journal of the European Economic Association*. doi:https://doi.org/10.1093/jeea/jvac032

Charles, M., & Bradley, K. (2009). Indulging our gendered selves? Sex segregation by field of study in 44 countries. *American Journal of Sociology, 114*(4), 924-976.

De Chaisemartin, C., & D'Haultfoeuille, X. (2022). *Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey*. Retrieved from

de Chaisemartin, C., D'Haultfoeuille, X., & Guyonvarch, Y. (2019). DID_MULTIPLEGT: Stata module to estimate sharp Difference-in-Difference designs with multiple groups and periods.

De Chaisemartin, C., D'Haultfoeuille, X., Pasquier, F., & Vazquez-Bare, G. (2022). Difference-in-Differences Estimators for Treatments Continuously Distributed at Every Period. *arXiv preprint arXiv:2201.06898*.

Elwert, F., & Winship, C. (2014). Endogenous selection bias: The problem of conditioning on a collider variable. *Annual Review of Sociology, 40*, 31–53. doi:10.1146/annurev-soc-071913-043455

England, P. (2010). The gender revolution: Uneven and stalled. *Gender & society, 24*(2), 149-166.

Falch, T. (2022). Aktuell analyse Er regional høyere utdanning viktig for regional rekruttering av kompetanse? *Samfunnsøkonomen, 2*. Retrieved from https://www.samfunnsokonomen.no/journal/2022/2/m-4658/Er_regional_h%C3%B8yere_utdanning_viktig_for_regional_rekruttering_av_kompetanse

Frisli, S., & Rogne, A. F. (2023a). *Higher educational institutions in Norway 1965-1994, version 1.0. Dataset.* Retrieved from: https://osf.io/7arqj

Frisli, S., & Rogne, A. F. (2023b). *Higher educational institutions in Norway 1965-1994, version 1.0. Documentation.* Retrieved from https://osf.io/du2rc

Gerber, T. P., & Cheung, S. Y. (2008). Horizontal stratification in postsecondary education: Forms, explanations, and implications. *Annu. Rev. Sociol, 34*, 299-318.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics, 225*(2), 254-277.

Gottfredson, L. S. (2002). Gottfredson's theory of circumscription, compromise, and self-creation. *Career choice and development, 4*, 85-148.
Herd, P., Freese, J., Sicinski, K., Domingue, B. W., Mullan Harris, K., Wei, C., & Hauser, R. M. (2019). Genes, gender inequality, and educational attainment. *American Sociological Review, 84*(6), 1069-1098.
Hermansen, A. S., & Penner, A. M. (2022). Trends in Women's and Men's College Majors across Four Decades in Norway. *Socius, 8*, 23780231221081692.
Jacobs, J. A. (1995). Gender and academic specialties: Trends among recipients of college degrees in the 1980s. *Sociology of Education*, 81-98.
Kirke- og undervisningsdepartementet. (1966). *Innstilling om videreutdanning for artianere m. v. Innstilling nr. 1 fra komitéen til å utrede spørsmål om videreutdanning for artianere og andre med tilsvarende grunnutdanning.* Oslo: Kirke- og undervisningsdepartementet Retrieved from https://www.stortinget.no/no/Saker-og-publikasjoner/Stortingsforhandlinger/Lesevisning/?p=1972-73&paid=3&wid=c&psid=DIVL753&pgid=c_0875&vt=c&did=DIVL757
Kirke- og undervisningsdepartementet. (1967). *Innstilling om videreutdanning for artianere m. v. Innstilling nr. 2 fra komitéen til å utrede spørsmål om videreutdanning for artianere og andre med tilsvarende grunnutdanning.*: Kirke- og undervisningsdepartementet Retrieved from https://www.stortinget.no/no/Saker-og-publikasjoner/Stortingsforhandlinger/Lesevisning/?p=1972-73&paid=3&wid=c&psid=DIVL753&pgid=c_0931&vt=c&did=DIVL873
Kirke- og undervisningsdepartementet. (1968). *Innstilling om videreutdanning for artianere m. v. Innstilling nr. 3 fra komitéen til å utrede spørsmål om videreutdanning for artianere og andre med tilsvarende grunnutdanning. Om distriktshøgskolenes organisasjon og administrasjon.* Oslo Retrieved from https://www.stortinget.no/no/Saker-og-publikasjoner/Stortingsforhandlinger/Lesevisning/?p=1972-73&paid=3&wid=c&psid=DIVL753&pgid=c_1007&vt=c&did=DIVL969
Kirke- og undervisningsdepartementet. (1969a). *Innstilling om vidareutdanning for artianere m.v. Innstilling nr. 4 fra Komitéen til å utrede spørsmål om vidareutdanning for artianere og andre med tilsvarende grunnutdanning. Om etterutdanning.* Oslo Retrieved from https://www.stortinget.no/no/Saker-og-publikasjoner/Stortingsforhandlinger/Lesevisning/?p=1972-73&paid=3&wid=c&psid=DIVL753&pgid=c_1047&vt=c&did=DIVL1013
Kirke- og undervisningsdepartementet. (1969b). *St. prp. nr. 136 (1968-69) Om prøvedrift med distriktshøgskolar.* Oslo: Kyrkje- og undervisningsdepartementet Retrieved from https://www.stortinget.no/nn/Saker-og-publikasjonar/Stortingsforhandlingar/Lesevisning/?p=1968-69&paid=2&wid=a&psid=DIVL1579
Kirke- og undervisningsdepartementet. (1970). *Innstilling om Videreutdanning for artianere m.v. Innstilling nr. 5 fra Komitéen til & utrede spørsmål om videreutdanning for artianere og andre med tilsvarende grunnutdanning.* Oslo Retrieved from https://www.stortinget.no/no/Saker-og-publikasjoner/Stortingsforhandlinger/Lesevisning/?p=1972-73&paid=3&wid=c&psid=DIVL753&pgid=c_1111&vt=c&did=DIVL1109
Kirke- og undervisningsdepartementet. (1973). *St. meld. nr. 66 (1972-73) Om den videre utbygging og organisering av høgre utdanning.* Oslo Retrieved from https://www.stortinget.no/no/Saker-og-publikasjoner/Stortingsforhandlinger/Lesevisning/?p=1972-73&paid=3&wid=c&psid=DIVL753&pgid=c_0745
Knutsen, T. K., Modalsli, J., & Rønning, M. (2022). *Distance and choice of field: Evidence from a Norwegian college expansion reform* Retrieved from https://modals.li/downloads/collegereform.pdf
Kyvik, S. (2014). Utviklingen av universitets-og høyskolesystemet i et europeisk perspektiv. . In N. N. Frølich, E. Hovdhaugen, & L. Terum (Eds.), *Kvalitet, kapasitet og relevans. Utviklingstrekk i norsk høyere utdanning* (pp. 80-94). Oslo: Cappelen Damm.
Lillehagen, M., & Isungset, M. A. (2020). New Partner, New Order? Multipartnered Fertility and Birth Order Effects on Educational Achievement. *Demography, 57*(5), 1625-1646.
Nåvik, Ø. (1997). *Vernepliktens historie 950-1996*. Oslo: Vernepliktsverket/Elanders Forlag.
Reisel, L., Skorge, Ø. S., & Uvaag, S. (2019). *En kunnskapsoppsummering*. Retrieved from Oslo:
Rizzica, L. (2013). Home or away? Gender differences in the effects of an expansion of tertiary education supply. *Gender Differences in the Effects of an Expansion of Tertiary Education Supply (June 21, 2013). Bank of Italy Occasional Paper*(181).

Russell, L. C., Yu, L., & Andrews, M. J. (2021). Higher education and local educational attainment: Evidence from the establishment of us colleges. *The Review of Economics and Statistics*, 1-32.

Raabe, M. (2002). Færre tar utdanning etter avsluttet videregående opplæring: bare en av tre elever fortsetter med utdanning. *Samfunnsspeilet, 6/2002*. Retrieved from https://www.ssb.no/utdanning/artikler-og-publikasjoner/faerre-tar-utdanning-etter-avsluttet-videregaaende-opplaering

Schofer, E., & Meyer, J. W. (2005). The worldwide expansion of higher education in the twentieth century. *American Sociological Review, 70*(6), 898-920.

Seehuus, S. (2021). Gender differences and similarities in work preferences: Results from a factorial survey experiment. *Acta Sociologica*, 00016993211060241.

Seehuus, S., & Reisel, L. (2017). The impact of social background on gender segregation in higher education. *TIDSSKRIFT FOR SAMFUNNSFORSKNING, 58*(3), 284-310.

Smeby, J.-C., & Terum, L. I. (n.a.). Akademisering. In *Store norske leksikon (snl.no)*.

Statistics Norway. (2002). Classification of economic regions. Retrieved from https://www.ssb.no/klass/klassifikasjoner/108/versjon/406/koder. https://www.ssb.no/klass/klassifikasjoner/108/versjon/406/koder

Statistics Norway. (2014). Classification of education (NUS). January 2014 - November 2016. Education (NUS) 2014. Retrieved from https://www.ssb.no/en/klass/klassifikasjoner/36/versjon/70/koder

Statistics Norway. (n.d.-a). Historisk statistikk. 5.11 Examen artium/fullført treårig allmennfaglig studieretning. Retrieved from https://www.ssb.no/a/histstat/tabeller/5-5-11t.html. from Statistics Norway https://www.ssb.no/a/histstat/tabeller/5-5-11t.html

Statistics Norway. (n.d.-b). Historisk statistikk. Tabell 5.14 Universiteter og høgskoler. Studenter. Retrieved from https://www.ssb.no/a/histstat/tabeller/5-14.html. from Statistics Norway https://www.ssb.no/a/histstat/tabeller/5-14.html

Støren, L. A., & Arnesen, C. Å. (2003). Et kjønnsdelt utdanningssystem. In 'Utdanning 2003–ressurser, rekruttering og resultater'. In *Statistiske analyser* (Vol. 60, pp. 136-160): Statistics Norway.

Terum, L. I., & Smeby, J.-C. (2014). Akademisering, kvalitet og relevans: Debatten om utdanningene til velferdsstatens profesjoner. I N. In N. N. Frølich, E. Hovdhaugen, & L. Terum (Eds.), *Kvalitet, kapasitet og relevans. Utviklingstrekk i norsk høyere utdanning. Cappelen Damm Akademisk: Oslo* (pp. 114-137). Oslo: Cappelen Damm.

United Nations Development Programme. (2022). Gender Inequality Index (GII). Retrieved from https://hdr.undp.org/data-center/thematic-composite-indices/gender-inequality-index

Wiswall, M., & Zafar, B. (2018). Preference for the workplace, investment in human capital, and gender. *The Quarterly Journal of Economics, 133*(1), 457-507.

Zafar, B. (2013). College major choice and the gender gap. *Journal of Human Resources, 48*(3), 545-595.

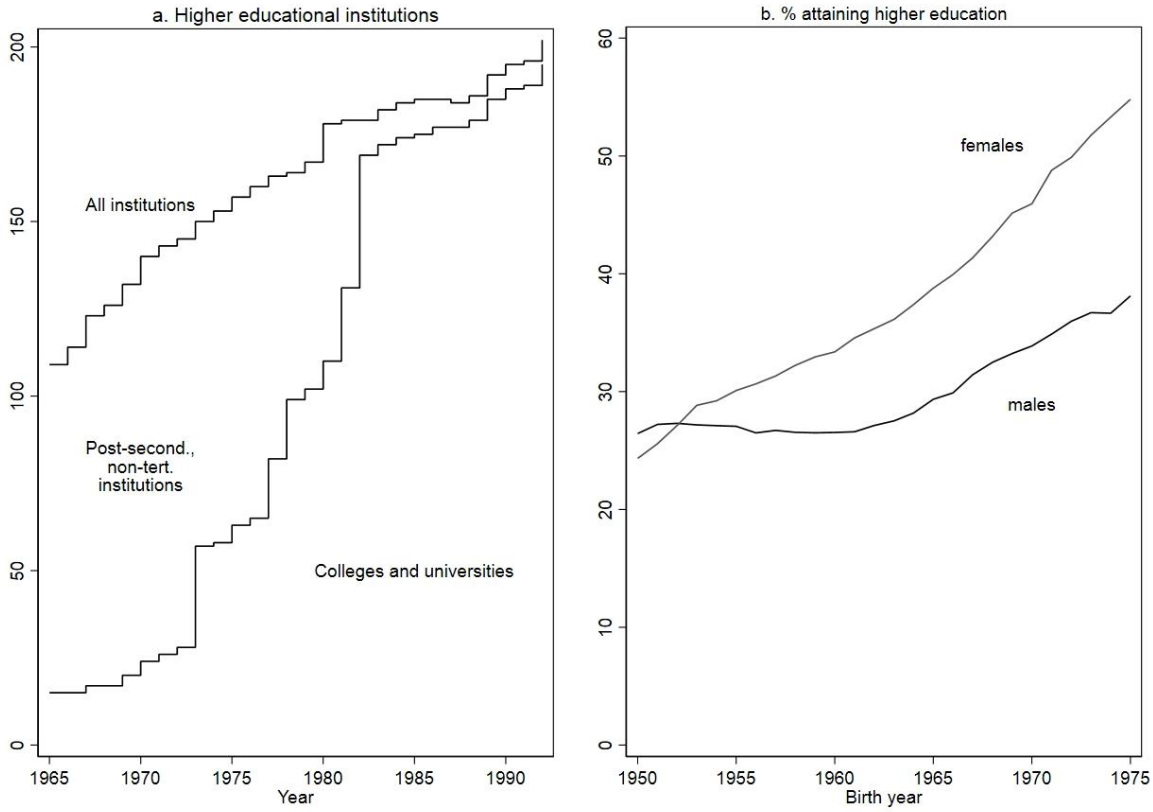
# Tables and figures

## Table 1: Descriptive statistics

| Year | 1968 | 1980 | 1992 |
|---|---|---|---|
| Cohort aged 17 at the beginning of the given year | 1950 | 1962 | 1974 |
| Number of colleges + post-secondary, non-tertiary institutions (PSNTI) | 126 | 178 | 202 |
| Number of colleges | 17 | 110 | 195 |
| Regions with a college or PSNTI (out of 89) | 30 | 38 | 40 |
| Regions with a college (out of 89) | 6 | 33 | 40 |
| Mean population size in regions with college or PSNTI | 85 480 | 80 640 | 83 043 |
| Mean population size in regions without college or PSNTI | 20 892 | 20 044 | 19 307 |
| Mean population size in regions with college | 20 4946 | 88 637 | 83 043 |
| Mean population size in all regions | 42 663 | 45 917 | 47 953 |
| % males attaining higher education in regions with college or PSNTI | 27.9 % | 28.2 % | 37.9 % |
| % males attaining higher education in regions without college or PSNTI | 23.8 % | 24.1 % | 32.5 % |
| % males attaining higher education in regions with college | 31.3 % | 28.5 % | 37.9 % |
| % males attaining higher education, total | 26.4 % | 27.1 % | 36.7 % |
| % females attaining higher education in regions with college or PSNTI | 25.2 % | 36.1 % | 54.0 % |
| % females attaining higher education in regions without college or PSNTI | 22.6 % | 33.1 % | 51.0 % |
| % females attaining higher education in regions with college | 28.9 % | 36.2 % | 54.0 % |
| % females attaining higher education, total | 24.3 % | 35.3 % | 53.3 % |
| Mean years of education in regions with college or PSNTI, males | 13.0 | 13.7 | 14.5 |
| Mean years of education in regions without college or PSNTI, males | 12.7 | 13.5 | 14.3 |
| Mean years of education in regions with college, males | 13.3 | 13.7 | 14.5 |
| Mean years of education total, males | 12.9 | 13.7 | 14.5 |
| Mean years of education in regions with college or PSNTI, females | 12.5 | 14.0 | 15.1 |
| Mean years of education in regions without college or PSNTI, females | 12.4 | 13.8 | 15.0 |
| Mean years of education in regions with college, females | 12.8 | 14.0 | 15.1 |
| Mean years of education total, females | 12.5 | 14.0 | 15.1 |
| Number of males (with non-missing education) | 30 441 | 31 155 | 30 697 |
| Number of females (with non-missing education) | 28 756 | 29 635 | 29 765 |
| % males attaining an education in… | | | |
| Agriculture/dairy/fishing | 0.32 % | 0.45 % | 0.59 % |
| Architecture/product design | 2.31 % | 1.56 % | 1.19 % |
| Art/dance/music/theatre | 0.30 % | 0.22 % | 0.47 % |
| Economics/administration/business/hotel | 3.41 % | 5.55 % | 6.74 % |
| Engineering/maritime/tech/STEM/biomed. | 6.43 % | 8.44 % | 9.11 % |
| Healthcare/health sci./social work/biology/Misc | 1.35 % | 1.60 % | 2.51 % |
| Humanities/social sci./law/journalism/pedagogics | 4.63 % | 4.23 % | 6.96 % |
| Odontology/pharmacology/medicine/veterinary sci. | 1.66 % | 0.80 % | 1.16 % |
| Sports/military/misc. | 0.81 % | 1.94 % | 4.52 % |
| Teacher education/theology | 5.24 % | 2.34 % | 3.39 % |
| % females attaining an education in… | | | |
| Agriculture/dairy/fishing | 0.05 % | 0.27 % | 0.43 % |
| Architecture/product design | 0.11 % | 0.57 % | 0.47 % |
| Art/dance/music/theatre | 0.30 % | 0.38 % | 0.59 % |
| Economics/administration/business/hotel | 1.61 % | 4.83 % | 6.95 % |
| Engineering/maritime/tech/STEM/biomed. | 0.58 % | 2.36 % | 3.66 % |
| Healthcare/health sci./social work/biology/Misc | 8.89 % | 11.84 % | 14.24 % |
| Humanities/social sci./law/journalism/pedagogics | 3.66 % | 5.65 % | 10.83 % |
| Odontology/pharmacology/medicine/veterinary sci. | 0.67 % | 0.94 % | 1.84 % |
| Sports/military/misc. | 0.24 % | 0.64 % | 1.94 % |
| Teacher education/theology | 8.24 % | 7.86 % | 12.34 % |
| Number of colleges providing educations in…* | | | |
| Agriculture/dairy/fishing | 1 | 2 | 3 |
| Architecture/product design | 1 | 2 | 2 |
| Art/dance/music/theatre | 4 | 17 | 19 |
| Economics/administration/business/hotel | 3 | 8 | 10 |
| Engineering/maritime/tech/STEM/biomed. | 3 | 25 | 32 |
| Healthcare/health sci./social work/biology/Misc | 2 | 10 | 80 |
| Humanities/social sci./law/journalism/pedagogics | 9 | 11 | 11 |
| Odontology/pharmacology/medicine/veterinary sci. | 8 | 9 | 9 |
| Sports/military/misc. | 2 | 16 | 18 |
| Teacher education/theology | 4 | 34 | 35 |

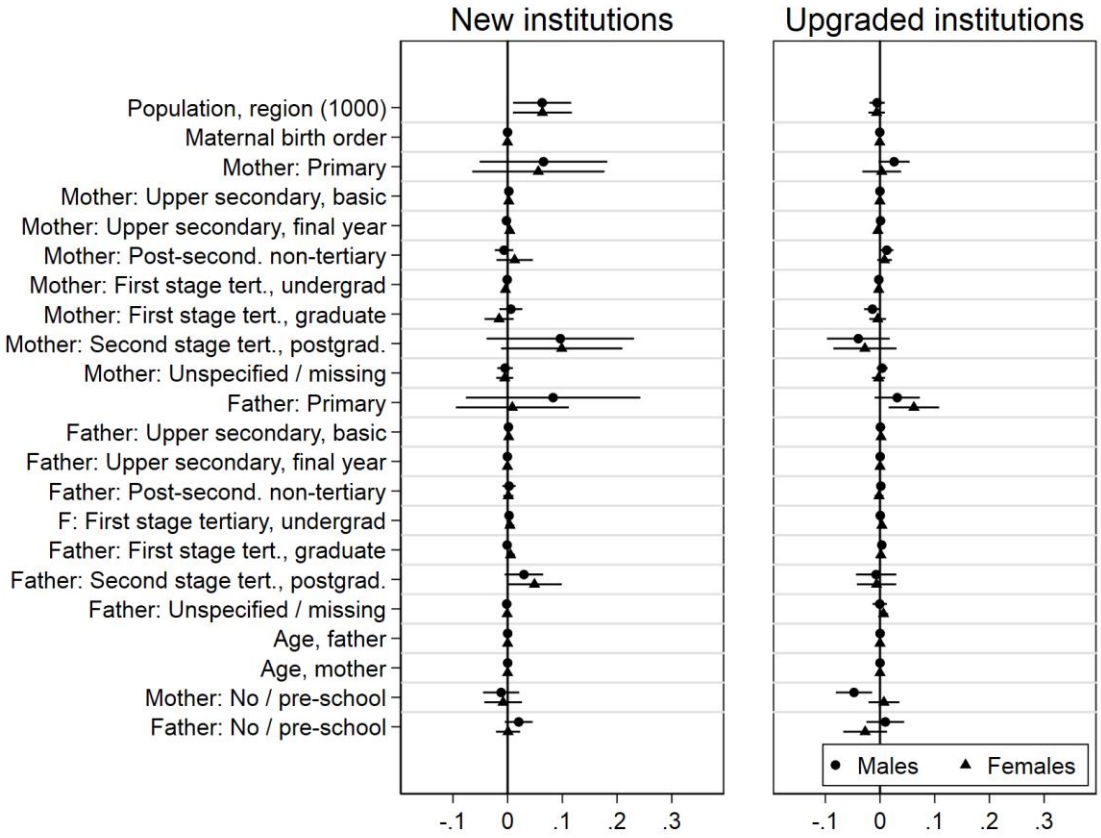
** Several universities and colleges offered multiple fields of study, so the number of fields is greater than the number of colleges.*

**Figure 1: Higher educational expansion**




*Note: Panel a is based on the Frisli and Rogne (2023a) data set on college expansions. Panel b is based on administrative register data provided by Statistics Norway. 'Jumps' in the number of colleges and universities are due to stepwise institutional upgrading reforms where post-secondary, non-tertiary institutions received college status (teacher schools in 1973/1975; social worker schools in 1975; technical (engineering) schools in 1976/1977; art, music and dance schools in 1978 and maritime and nursing schools in 1980-82).*

**Figure 2: Coefficients from balance tests**

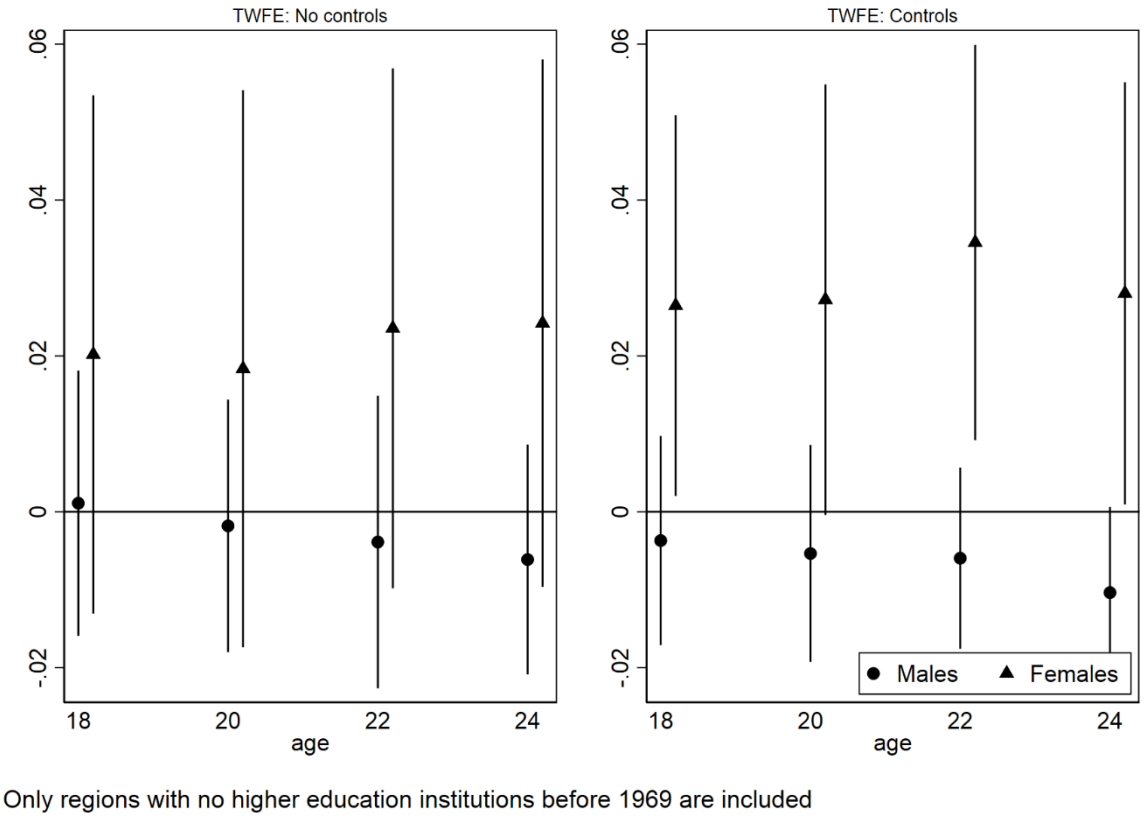



*Note: TWFE models estimated separately by sex.*

**Figure 3: Trends in educational attainment over cohorts, by sex**


*Source: Authors' calculations based on administrative register data. Conditional on residency at age 17.*

**Figure 4: The impact of higher educational institutions on higher educational attainment among males and females; TWFE estimates**




*Source: Authors' calculations based on administrative register data. Conditional on residency at age 17. Each point represents the estimate from a separate model.*

**Figure 5: The impact of local higher educational institutions on higher educational attainment; event study estimates without controls.**

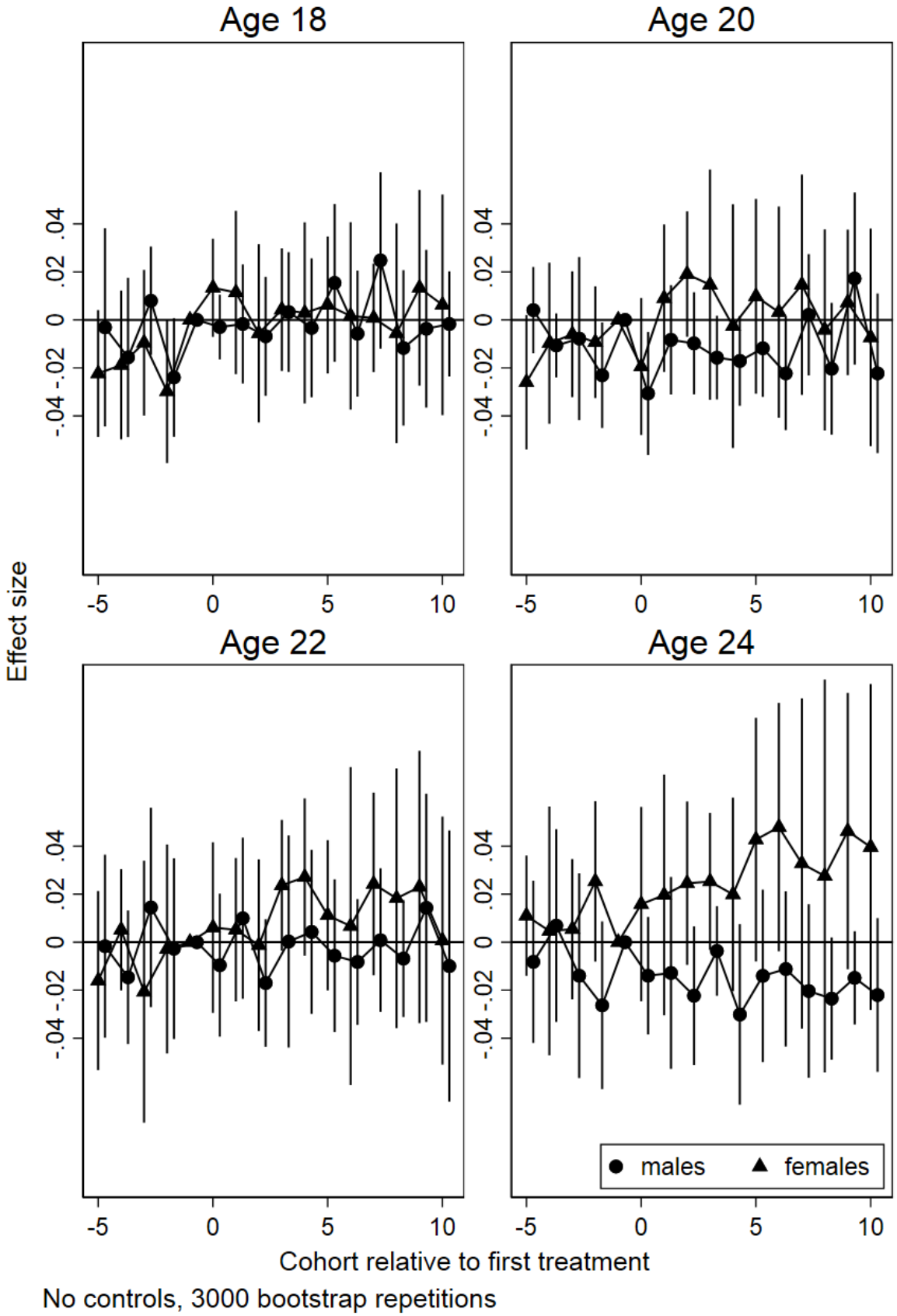
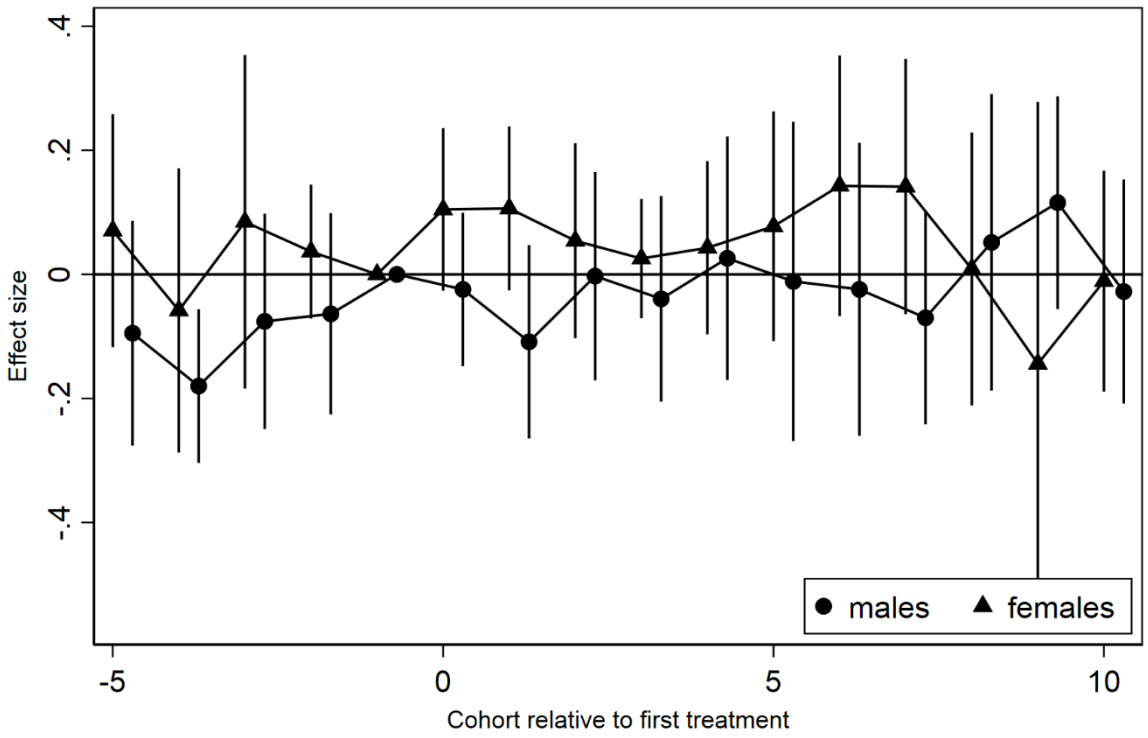


**Figure 6: The impact of institutional upgrading or the establishment of new colleges in regions with post-secondary, non-tertiary institutions on years of schooling; event study estimates without controls at age 20.**




Effect of institutional upgrading/new colleges in regions with post-secondary, non-tertiary institutions on years of schooling, age 20, no controls, 3000 bootstrap repetitions

**Figure 7: Field of study among males and females.**

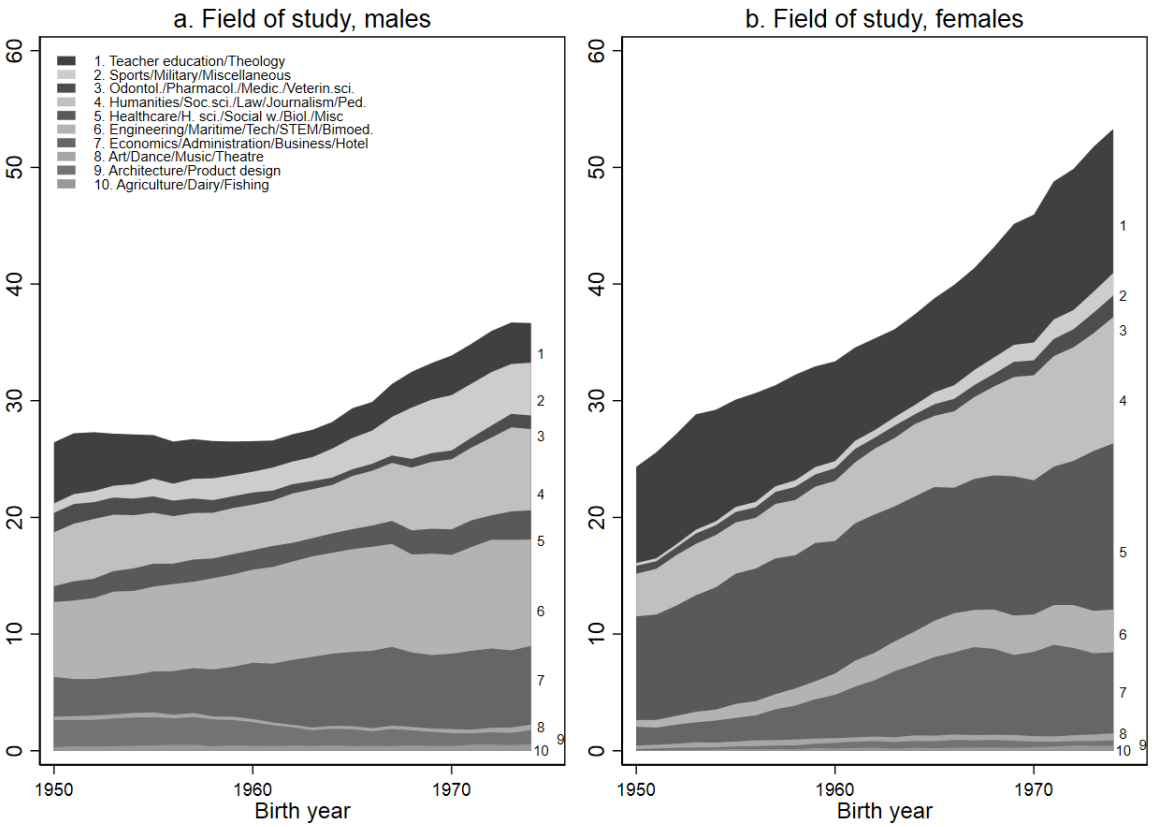
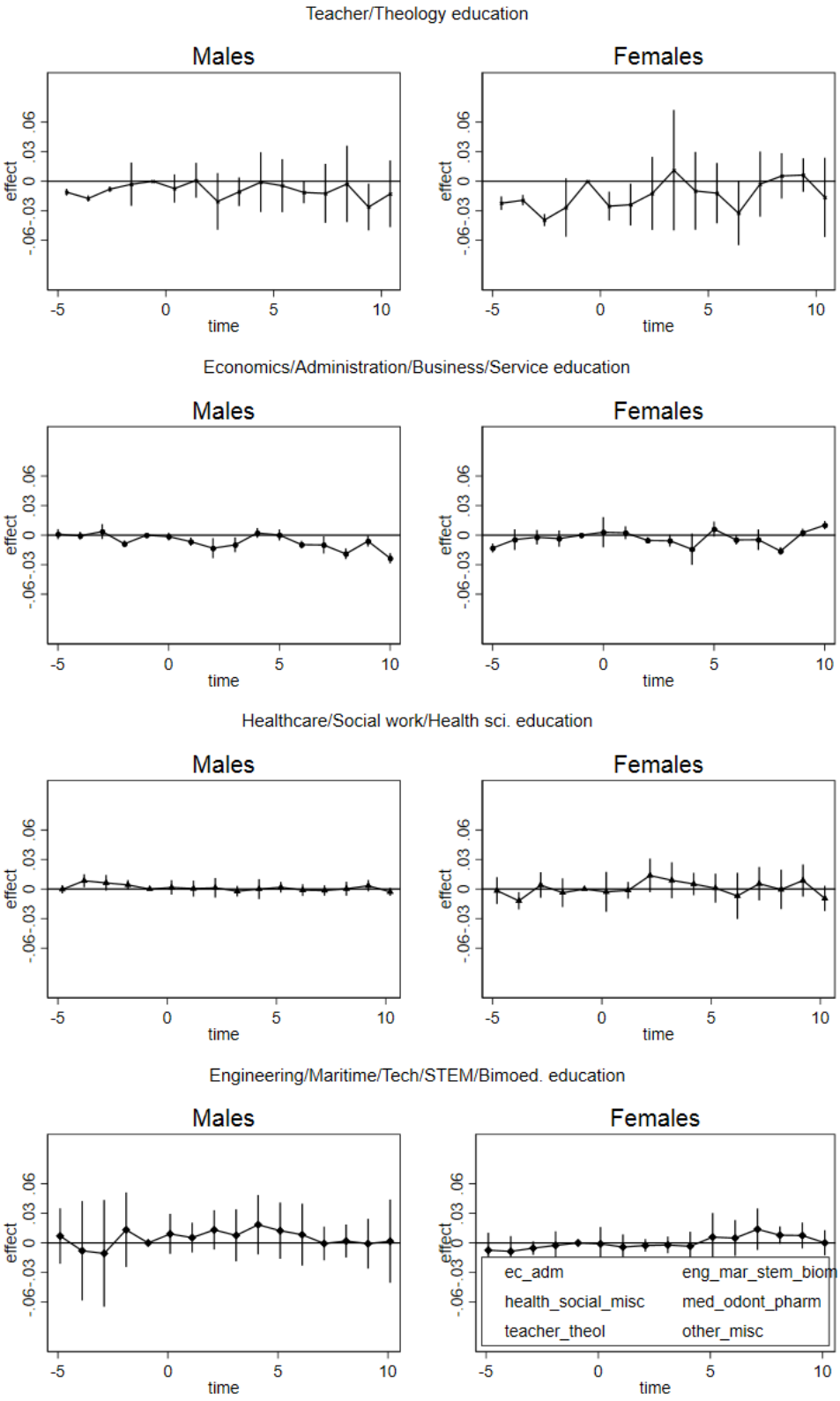


**Figure 8: The impact of local higher educational institutions in specific fields on higher educational attainment in those fields; event study estimates controlling only for the presence of other educational institutions.**




Controls only for colleges offering educations in other fields.
3000 bootstrap repetitions