ETLA Working Papers | 85 11.1.2021

The Effect of Access to Post-Compulsory Education: Evidence from Structural Breaks in School Supply

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Suggested citation:
Virtanen, Hanna & Riukula, Krista (11.1.2021). "The Effect of Access to Post-Compulsory Education: Evidence from Structural Breaks in School Supply".

ETLA Working Papers No 85.
http://pub.etla.fi/ETLA-Working-Papers-85.pdf

Abstract

We study how reducing the regional supply of post-compulsory education affects schooling choices and educational attainment in Finland. We exploit variation across municipalities and over time in the availability of three secondary education tracks: general education, and the vocational fields of technology and services. According to our results, access to general education mainly affects decisions regarding what to study, whereas reducing the regional availability of vocational education also postpones studies and may even decrease the educational attainment of local youth. Our results also suggest that school consolidations may have a substantial impact on labor market trajectories. We find that the initial enrollment choices of men are more sensitive to supply reductions than those of women, and that the field of technology is particularly important for individuals with less-educated mothers.

Tiivistelmä

Toisen asteen alueellinen tarjonta ja koulutusvalinnat

Tässä tutkimuksessa tarkastellaan, miten toisen asteen koulutuksen saatavuuden vähentäminen vaikuttaa alueen nuorten koulutusvalintoihin, opintojen etenemiseen ja työmarkkinoille sijoittumiseen Suomessa. Hyödynnämme tutkimuksessa lukiokoulutuksessa sekä tekniikan ja palvelualojen ammatillisessa koulutuksessa 2010-luvulla tapahtuneita jyrkkiä tarjonnan supistamisia.

Tulostemme perusteella lukiokoulutuksen alueellisen saatavuuden heikentäminen vaikuttaa ennen kaikkea nuorten koulutusalavalintaan, kun taas ammatillisen koulutuksen tarjonnan supistamisella voi olla merkitystä myös sekä toisen asteen tutkinnon suorittamistodennäköisyyteen että valmistumiseen käytettyyn aikaan. Lisäksi alueellisen koulutuksen tarjonnan vähentäminen vaikuttaa nuorten menestykseen työmarkkinoilla ainakin vielä 21-vuotiaana. Tutkimuksemme osoittaa, että 16-vuotiaana tehtävät koulutusvalinnat ovat alueen koulutuksen tarjonnan suhteen miehillä herkempiä kuin naisilla. Tekniikan alan koulutuksen saatavuus näyttäisi olevan erityisen tärkeää niille nuorille, joiden äideillä ei ole mitään peruskoulun jälkeistä tutkintoa.

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KTT **Hanna Virtanen** on Elinkeinoelämän tutkimuslaitoksen tutkimuspäällikkö.

KTT **Krista Riukula** on Elinkeinoelämän tutkimuslaitoksen tutkija.

Acknowledgements: We thank Antti Kauhanen, Olli Ropponen, Mikko Silliman, and Roope Uusitalo for their valuable comments. We would also like to acknowledge Niilo Laiho, Siiri Naumanen, and Pekka Vanhala for providing the excellent research assistance and Lotta Väänänen for her involvement in the earlier stages of the project. Financial support from the TT Foundation (Teollisuuden ja työnantajain keskusliiton säätiö) is gratefully acknowledged.

Kiitokset: Kiitämme Antti Kauhasta, Tuomas Pekkarista, Olli Ropposta, Mikko Sillimania ja Roope Uusitaloa hyödyllisistä kommenteista. Lisäksi haluamme kiittää Niilo Laihoa, Siiri Naumasta sekä Pekka Vanhalaa tutkimusavusta. Tutkimus on osa TT-säätiön rahoittamaa hanketta.

Keywords: School consolidation, Post-compulsory education, Vocational education, School choice, Student mobility, Education supply

Asiasanat: Koulutuksen tarjonta, Koulutuksen keskittäminen, Toinen aste, Ammatillinen koulutus, Koulutusvalinnat, Liikkuvuus, Koulutuksen keskeyttäminen

JEL: I2, I21, I24, H40, J24

1 Introduction

School consolidations (school closures, mergers, and expansions) have become an increasingly popular policy measure across Western countries facing decreasing fertility, fiscal constraints, and increasing learning disparities. In Finland for example, the number of post-compulsory schools has dropped by over 30 percent in the last two decades (Figure 1).[1] School consolidations aim at improving school quality, decreasing segregation, and/or reducing education expenditure. However, school closures and regional supply reductions might also have some undesirable consequences for the schooling choices and outcomes of young people locally. This is particularly the case for post-compulsory education, where adolescents can even decide to drop out of school altogether as a result of decreased access to education. Nonetheless, in sharp contrast to a rapidly growing body of evidence related to school closures in compulsory schooling (e.g. Beuchert et al., 2018; Berry and West, 2010; Brummet, 2014; Engberg et al., 2012; Steinberg and MacDonald, 2019), we are aware of only one paper, by Grau et al. (2018), studying the impact of closing post-compulsory schools (i.e. secondary schools). Whereas their paper focuses on disruption effects for displaced students, we aim to contribute to a more general question about the effects of reducing regional availability of post-compulsory education. We exploit exogenous variation in the timing of supply reductions across regions in Finland to study the effect of reducing access of post-compulsory education on schooling choices and educational attainment.

Reducing the regional availability of post-compulsory education may affect education choices by increasing distance to schooling, and thus the costs of school-

[1] Closing small or low-performing schools has been similarly common also in the US (Brummet, 2014; Steinberg and MacDonald, 2019), Denmark (Beuchert et al., 2018), and Sweden (Taghizadeh, 2020), for example.

ing.[2] On the other hand, the added costs may affect choices to participate in education, or sorting of individuals across education tracks and schools. These decisions may have long-lasting effects on the schooling and career paths of individuals.[3] Furthermore, school consolidations may increase the regional disparities in the availability of education and thus, introduce inequalities in human capital accumulation between individuals living in different regions. They may also boost differences in skill composition between regions.

Research on the effects of school consolidations has concentrated almost exclusively on the effects of closing compulsory schools, and thus the main interest has been in academic achievement, and in some cases also in absences. Overall, existing literature suggests that both displaced students and students at receiving schools experience no or small negative effects (Beuchert et al., 2018; De la Torre and Gwynne, 2009; Engberg et al., 2012; Izadi, 2015; Liu et al., 2010; Taghizadeh, 2020). Moreover, the effects are typically short-lived and the achievement gains from moving to a higher-performing school may outweigh the negative disruption effects for displaced students (Brummet, 2014; De Haan et al., 2016; De la Torre and Gwynne, 2009; Engberg et al., 2012; Steinberg and MacDonald, 2019; Carlson and Lavertu, 2016). Prior research also discusses the potential negative effects from students having fewer schools to choose from and schools experiencing less competition after consolidations.[4]

Grau et al. (2018) provide the only available evidence on the effects of closing

[2]Distance-related costs include the direct financial costs of moving or commuting, emotional costs associated with leaving home, and information costs when seeking information on schooling options.

[3]Participation in post-compulsory schooling is critical for the later success of individuals (e.g. Doyle and Skinner, 2016; Lochner, 2011; Oreopoulos, 2007), and even a gap year after compulsory education may have severe consequences (Huttunen et al., 2019; Virtanen, 2016). Moreover, the labor market returns to various secondary education tracks may vary substantially (Silliman and Virtanen, 2019).

[4]Berry and West (2010) show that students from states with larger schools (as a result of consolidations) perform worse in terms of educational attainment and labor market outcomes, whereas De Haan et al. (2016) find no evidence of negative effects from decreased choice and competition.

post-compulsory schools. They find that school closures substantially increase the probability of high-school dropout and grade retention for the displaced students in Chile.[5] In a related study Lovén et al. (2020), explore the effects of reducing supply at a university in Sweden on education and migration choices. They show that women react to supply reduction by enrolling in another university further away, whereas the likelihood of men moving is unaffected, leading to decreased likelihood of studying at a university.[6]

We extend the existing research by focusing on the effects of reducing the regional supply of post-compulsory education. There are substantial differences in terms of curricula, career prospects, as well as in popularity across education fields (see e.g. Table 1). To get a better understanding of the importance of access to various education alternatives, we perform our analysis separately for the three most prevalent secondary education tracks: general education, and the vocational fields of technology and services.

The Finnish education system provides an attractive context for our study. The quality differences between secondary schools are very small (Kortelainen and Manninen, 2019; Tervonen, 2016), and the main motivation for school consolidations has been to save on fixed costs and to reap benefits from economies of

[5]To examine the effects on dropping out, Grau et al. (2018) compares the outcomes of students in the same school and grade in cohorts in the year before the school closure and the year of closure. Instead, to examine the effects of school closure on class retention the paper assesses the performance of students from closed schools relative to their classmates in the receiving school. Moreover, Grau et al. (2018) estimate the impact of school closures for reasons of market competitiveness rather than political decisions as is typical for most of the other studies.

[6]There is also an extensive literature focused on the role of regional availability in education choices. These studies use cross-sectional variation in regional supply and find that access to education is at least associated with the choice to participate in education (e.g. Gibbons and Vignoles, 2009; Spiess and Wrohlich, 2010), as well as with the choice of what and where to study (e.g. Dickerson and McIntosh, 2013; Falch et al., 2013; Kelchtermans and Verboven, 2010a,b; Suhonen, 2014). The challenge with these analyses is the selection of families into regions. Moreover, with the exception of Dickerson and McIntosh (2013) and Falch et al. (2013), all of these studies focus on higher-education choice. However, the regional supply of education may be of particular importance at the lower education level as younger age groups are likely to be less mobile than older groups.

scale (e.g. Izadi, 2015). Hence our empirical analysis gives us a clearer view of the effects of regional availability of post-compulsory education. Moreover, rich Finnish registry data provides a great opportunity to explore the effects of supply reductions on various schooling choices and outcomes unexplored in the prior literature.

Since school closures are not random, displaced students (or individuals in municipalities with supply reductions) may differ systematically from students in remaining schools (in municipalities with stable supply). Most of the prior research has used a difference-in-differences (DD) strategy (Beuchert et al., 2018; Brummet, 2014; Engberg et al., 2012; Lovén et al., 2020; Steinberg and MacDonald, 2019) or a combination of matching and DD strategies (De la Torre and Gwynne, 2009; Grau et al., 2018; Liu et al., 2010) to take into account the differences in student trajectories. Moreover, Berry and West (2010) exploit variation in the timing of school consolidations to overcome selection issues. A few papers also utilize consolidation reforms (De Haan et al., 2016) or rules that force closures on schools failing to meet certain performance standards or minimum size requirements (Carlson and Lavertu, 2016; Ong and De Witte, 2014).

We follow a very similar empirical strategy and employ difference-in-differences and event study strategies that exploit variation in the education supply across municipalities and over time. We search for sharp changes in the municipality-field-level schooling supply exploiting the structural breaks method used in Charles et al. (2018) and Lafortune et al. (2018). We use the timing and magnitude of the estimated structural breaks in the regional availability of education to divide the municipalities into treatment and control groups. We compare the educational outcomes in regions with significant supply reductions (i.e. a relatively large negative structural break) in one of the three secondary fields to those in regions

with a stable supply of the given education track during the observation period. These supply reductions are typically driven by a school closure, even when it is not necessarily the last school offering the given secondary education field in the municipality. Our results are robust to defining the treatment and control municipalities based on the year-to-year changes in schooling positions per cohort. We show that structural breaks do not systematically vary with the municipality-level characteristics, and, more importantly, that the pre-trends are similar across treatment and control municipalities. Moreover, our results are robust to defining the municipality of residence based on the year of birth. This strategy removes any potential bias stemming from family moving patterns correlating with changes in supply.

Our results show that access to post-compulsory education has substantial effects on the enrollment choices of 16-year-olds, and that these effects vary by education track. More specifically, we find that reducing the supply of the general track shifts individuals from general education into vocational education. Quite surprisingly, we find that the same is true when there is a drop in the supply of the vocational field of technology. Increased student mobility may provide a potential explanation for this finding. According to our results, reducing the regional availability of vocational tracks increases the likelihood of enrolling somewhere further away (outside the municipality of residence). Hence, supply cuts may also influence the choice set of education alternatives. This makes predicting student responses very difficult.

Our results also suggest that there may be some longer-term consequences from supply reductions. Namely, we find that reducing the access to vocational education at least postpones graduation from post-compulsory education, and may even lead to a lower level of educational attainment. Moreover, we are able to

follow labor market outcomes until the age of 21. This is too early for definitive conclusions, but these results suggest that changes in initial enrollment choices may also have a substantial impact on labor market trajectories.

Our findings reveal substantial heterogeneity in the sensitivity to reduced regional access to education by gender and parental background. Our results suggest that the effects of regional availability on initial enrollment choices are most pronounced for men. Moreover, access to the vocational field of technology appears to be very important for those with less-educated mothers. In particular, reducing the supply of technology education supply may have a detrimental effect on their labor market participation.

Our study provides important insight into the effects of school consolidation on post-compulsory education choices and outcomes. Shrinking cohort sizes will increase pressure to further reform the schooling network.[7] Although they potentially save school expenditure or even improve average school quality in the remaining schools, school consolidations have the potential to generate large welfare losses. These effects should be better taken into account when considering education reforms that reduce the regional availability of post-compulsory education in some regions.

2 Post-compulsory education in Finland

A few features of the Finnish education system make it an appealing context for our study. Firstly, Finland is a geographically large and sparsely inhabited country and there has been considerable pressure for major school consolidations. Moreover, the quality differences between secondary schools are very small (Korte-

[7] According to the data on population changes of Statistics Finland, the birth rate fell in Finland for the eighth consecutive year in 2018.

lainen and Manninen, 2019; Tervonen, 2016). This provides a clearer set-up in which we can focus on the effects of reducing the regional availability of education. Finally, students are free to apply to any post-compulsory education across the country and thus there are no mechanical limitations driving the results.

Figure 2 provides a graphical illustration of the Finnish educational system.[8] In Finland, compulsory education consists of nine years of comprehensive schooling and it typically ends the year when the pupil turns 16 years old. During our observation period (1997-2013), around 90 percent of the cohorts finished compulsory education at the age of 16 years. Post-compulsory education includes two types of tracks: general tracks (sometimes referred to as the academic track, high school, or gymnasium) and vocational tracks. General education provides the basis for access to tertiary education, whereas vocational education prepares students for specific occupations. Vocational tracks are divided into seven broad fields: educational science, arts and humanities, business and social science, technology, agriculture and forestry, health and welfare, and services.

The scope of the syllabus for both types of tracks is three years.[9] Vocational education does not preclude the option of continuing to higher education, although students in the general track are much more likely to enter higher education. Moreover, in contrast to their peers in the general track who typically enter academically focused universities, graduates of the vocational track are more likely to enroll in universities of applied sciences (UAS).

Post-compulsory education is provided by local authorities, municipal con-

[8] For reference, the description of the institutional context in this paper is based on Huttunen et al. (2019) and Silliman and Virtanen (2019), but modified to highlight features relevant to this study.

[9] Prior to an education reform at the end of the 90s, vocational education programs were mainly two years long and almost exclusively consisted of vocation-specific content. Under the reform programs were prolonged by an additional year and gained a considerably larger general content. Part of the roll-out period of the reform overlaps with our pre-treatment years. Our results are not sensitive to excluding these years (Section 6.2).

sortia or other organizations authorized by the Ministry of Education. A license to provide secondary education defines the maximum number of students per educational field. Educational institutions decide how these schooling positions are divided between the education programs they provide in each field. Secondary education in Finland is publicly funded and free of charge for students.

Applications to post-compulsory education are made through a centralized application system maintained by the Finnish National Agency for Education. Applicants rank their preferences for secondary school, including as many as five school and program combinations. In the cohorts we study (1997-2013), approximately 98 percent of the 16-year-olds leaving compulsory education apply to secondary education the same year. Close to 60 percent of them rank the general track as their first choice, and just over 40 percent out vocational education first.

Allocation of positions to secondary schools is based on admission scores and student selection follows a deferred acceptance (DA) algorithm. Post-compulsory education is provided by local authorities, municipal consortia or other organizations authorized by the Ministry of Education and Culture. A license to provide education defines the maximum number of students per school and educational track. Education providers determine supply within the limits of their license. The number of positions in each educational program is fixed and announced before the application process begins.

In line with international trends, there has been considerable pressure for major school consolidations in Finland. The main motivation for supply reductions has been to restrain schooling expenditure, i.e. to save on fixed costs and reap benefits from economies of scale (Izadi, 2015). Figure 1 depicts the development of the number of secondary schools providing general and vocational education between 2000 and 2018. The number of general secondary schools dropped by 20

percent and the number of vocational secondary schools by 50 percent during the observation period. This provides a good testing ground for sensitivity to regional supply.

3 Data

We use two main sources of data. First, we have information on the supply of post-compulsory education for the years 1999-2013 from the Finnish National Agency for Education. We merge this data with population-wide Finnish administrative registers from Statistics Finland for the years 1997-2018, which contain data on education and labor market outcomes, as well as on individual and family characteristics.

The supply data provides us with information on the supply of schooling positions per municipality, educational institution, and educational program each year. Our analysis uses within-time variation in the educational supply across municipalities, and thus we aggregate the supply-side information to a municipality level using a municipal classification for the year 2015. Moreover, we reduce the dimensionality by aggregating the supply data into eight fields of education (a general track and seven fields of vocational education).

According to our data, 77 percent of the 311 municipalities provided at least one field of secondary education in the beginning of our observation period in 1999. The general track was most prevalent, being offered on average in 76 percent of the municipalities, whereas 46 percent of the municipalities offered at least one field of vocational education. Among vocational fields, the technology track and the business and social sciences track were most widespread, being offered in about 33 percent and 21 percent of the municipalities, respectively. The services track was offered only in about 13 percent of the municipalities in 1999.

By the end of the observation period in 2013, the share of municipalities supplying at least one field of secondary education had dropped by only 1.2 percent. Additionally, 8.7 percent of the municipalities had experienced a closure of some secondary education field (general education or one of the seven vocational fields) by 2013.[10]

We link the supply-side information to individuals for the year they turn 16 years old. To take into account the possibility that families may react to changes in supply by moving, the municipality of residence is matched to individuals in the year they turn 15. For robustness, we determine the municipality of residence based on the year of birth, removing any potential bias stemming from family moving patterns correlating with changes in supply. These results are in line with our baseline results (Section 6.2). The FOLK data from Statistics Finland includes detailed information on individual characteristics (year of birth, municipality of residence, gender, nationality, mother tongue), parental background (socioeconomic status, education, and income) as well as on regional characteristics (population, employment etc.). Moreover, the FOLK data provides us with measures for labor-market outcomes until the age of 21 years (a balanced panel with data up to 2018) .

We use several measures of schooling choices and outcomes. From the Application Registry of the Finnish National Agency for Education we have information on compulsory school performance, secondary school application preferences, and secondary school admissions results. To measure educational attainment, we use the Student and Degree Registers, which contain information on the year, level, and field of all post-compulsory enrollment and completed degrees.

[10]In our analysis, we exploit substantial municipal-field-level education supply reductions. These may be driven by the closure of a school in the given municipality, even when it is not the last school offering the given field.

4 Empirical strategy

4.1 Structural breaks in the supply of education

This paper studies how the regional supply of post-compulsory education, i.e. access to secondary education, affects schooling choices and educational attainment. A key challenge in our empirical analysis is that families do not randomly allocate to different regions. A decision to move somewhere may even be directly affected by the regional availability of post-compulsory education. Moreover, the supply may correlate with other characteristics in the region. To account for possible selection bias, we exploit variation in educational supply across municipalities and over time arising from school closures and other significant reductions in post-compulsory education supply.[11]

We exploit a structural breaks method to determine sharp changes in secondary schooling supply at the municipality-field level.[12] Our econometric approach is similar to recent work by Charles et al. (2018) on housing booms, and by Lafortune et al. (2018), that estimates sharp breaks in school finances due to major legal reforms. These studies assume that housing prices evolve at a constant rate and abrupt changes in the growth rate are caused by a demand shock. Instead, we argue that field-level education supply is typically quite stable due to high fixed costs and administrative rigidity (see Section 2). Moreover, we search for sharp breaks in the level of education supply driven by substantial rearrangements of the schooling network in a region. Our strategy is based on the idea that the timing of these changes is exogenous. This relies on the assumption that the underlying fundamentals do not change abruptly and are smoothly incorporated

[11] Supply reductions are typically driven by a school closure, even when it is not the last school offering a given secondary education field in the municipality.

[12] For robustness, we use an alternative definition of treatment group: municipalities that experienced at least a 50 percent drop in the supply of secondary education (see Section 6.2)

into schooling supply when they do change. Our strategy is based on the idea that the timing of these sharp changes is exogenous. This relies on the assumption that the underlying fundamentals do not change abruptly and are smoothly incorporated into schooling supply when they do change.

Using yearly supply data for the years 1999 to 2013, we estimate municipality-field-specific OLS regressions with a single structural break and search for the location of the break which maximizes the R^2 of the following regression:

$$S_{mft} = \alpha_{mf} + \delta_{mf} 1\left\{ t > t^*_{mf} \right\} + \varepsilon_{mft} \quad (1)$$

where S_{mft} represents the supply of field f in municipality m in year t measured as the number of schooling positions per the number of 16-year-olds living in the municipality. t^*_{mf} is the year of the structural break in the municipality-field-specific time series, and α_{mf} is the level of the educational supply before the structural break. Finally, δ_{mf} is the size of the structural break: the magnitude of the change in the supply of the given field in municipality m at the break. Negative values for the structural break denote a drop and positive values growth in the educational supply. For municipalities where the schooling supply for field f does not change much over the years, our estimates of δ_{mf} will be close to zero.

For each field, we divide municipalities into three break groups based on the value of their maximum break, that is the structural break that maximizes R^2. The first ("drop") group consists of municipalities that experience a negative structural break of a magnitude of -1.0 to -0.1. The municipalities in the second ("growth") group have a positive structural break between 0.1 and 1.0. Finally, the third ("flat") group consists of municipalities with relatively stable supply: the maximum break is between -0.1 and 0.1. Our results are robust to using different cut-offs, such as -1.0 to -0.2 for negative breaks (see Section 6.2).

We include only those municipalities for which the maximum breaks occur during the years 2002-2008. The drop in the supply takes place the year following the break year, i.e. between the years 2003-2009. This gives us a balanced five years before treatment, and five-year follow up periods for five cohorts before and after the break.[13] Sufficiently long pre-treatment and and post-treatment periods allow us to carefully explore the validity of our research design. By limiting to these years, we are able to explore educational and labor market outcomes until early twenties. For robustness, we also repeat the analysis using the structural breaks between the years 2007 and 2013 (Section 6.2). These estimations are possible only for outcomes measured at age 16.

After this restriction, the number of municipalities in the break groups is reasonably large only for the general track and two tracks of vocational education: technology and services. Of the 311 municipalities in our data, 22 municipalities belong to the drop group for the general track, 16 in the flat group, and 18 in the growth group. The corresponding figures for the field of technology are 7, 10, 32, and for the field of services 9, 16, 3, respectively. Figure 3 shows the geographical distribution of the break groups for each of the three secondary education fields in Finland. The category "other" consists of municipalities that do not provide the given secondary education field between the years 2002-2008, or experience their largest structural break before or after these years. Moreover, we have excluded a few outliers for which the estimated maximum negative structural break is below -1.0. The results are robust to including these municipalities (not reported).

In our empirical analysis, we focus on the effects of supply changes in these three secondary education alternatives. Table 1 presents the distribution of the first application choices into general and vocational education, and across vocational fields (conditional on applying to vocational education). According to these

[13] With the exception of the supply data, our research data is available for the years 1997-2018.

statistics, the education tracks studied here are the three most popular secondary education tracks. Women and those with more educated parents apply more often to general education, whereas vocational education is more popular among men and those whose mother has no post-compulsory degree. The field of technology includes programs in manufacturing, construction, and transportation, for example. Education programs in the field of services, on the other hand, consist of services in hotel and catering, beauty care, and security services, for example. We can see from Table 1 that the technology track is particularly popular among men, whereas women more often put the field of services as their first choice.

Figure 4 illustrates how the estimated structural breaks link to the supply of secondary education over time. The figure depicts yearly schooling supply per cohort for the three secondary fields in the nine example municipalities. We find that the municipalities with large negative (positive) breaks also experience a clear drop (growth) in the level of their supply. On the other hand, there is only moderate yearly variation in supply in the municipalities in the flat groups. Centering the supply data at estimated structural break years allows us to pool the data on all the municipalities in each group of each field. Figure 5 reports the average supply for municipalities in each group for the three education fields for the period from three years before the break to five years after the structural break. The figure highlights the relevance of the estimated structural breaks for education supply: estimated maximum breaks do a decent job in dividing the municipalities into groups with similar trends in supply. According to these results, the number of schooling positions per cohort drops on average by approximately by 20 percent following the estimated structural break. Moreover, we can see that there is also a significant drop in the number of schools per cohort size, implying that our identification is often driven by school closures, even if the school closing is not

the last school offering the given education field in the given municipality.

Table 2 shows the means of individual characteristics and parental background for the universe of 16-year-old individuals living in Finland in 1997-2013, and for each break group for the three education fields. Table 3 provides information on municipal-level variables. According to these statistics, there appears to be very little difference between the break groups, also when comparing the groups to the total population. Native Swedish-speakers are slightly over-represented in the drop groups. Additionally, individuals in the municipalities with relatively stable supply have higher parental income and education. However, the most distinct differences between the groups are in the size and urbanization of the municipalities. The municipalities in the flat group are clearly the largest and the most urban, whereas the municipalities in the drop group are mainly small semiurban or rural municipalities.[14]

Figure 3 presents the geographical distribution of the municipalities in each group. The figure shows that the break groups are not geographically concentrated in certain areas, rather there is spatial variation. Moreover, we find that there is not much overlap in the break groups of different fields (see Table A1 in the appendix for the list of the municipalities in the drop break group) indicating that a drop in education supply typically occurs at the field level.

In the analysis, we focus solely on the effects of negative structural breaks, i.e. how supply reductions affect enrollment choices and educational attainment. It would be interesting to also study the effects of growth in supply. However, the channels linked to growth in supply and educational outcomes are not trivial.

[14]In fact, there appear to be no urban municipalities in the drop group for the two vocational fields, whereas urban is the most common municipality type for the flat break groups. However, since we must aggregate our data for some of the municipalities synthetically (in order to use the DD strategy, we use the same classification for all the years from 2015), this variable might not be very informative. We re-run our specification with a sample excluding the urban municipalities altogether, and show that our results are not sensitive to this change (Section 6.2).

Whereas supply cuts are likely to only induce outward mobility, growing supply may also attract inward mobility. Separating the effect of increased competition in the region from the effects of increased education supply would require a structural model. Instead, it is more straightforward to estimate the effects of supply reductions without confounding effects from changes in the relevant cohort. The next section describes our empirical strategy. We assess the validity and robustness of our research design in Section 6.

4.2 Empirical specification

To identify the causal effects of access to post-compulsory education on schooling outcomes, we adopt a difference-in-differences (DD) approach and exploit exogenous variation in the timing and size of the structural breaks. We use individual-level data with municipal-year-level variation in the supply of education, i.e. we compare the outcomes of cohorts who are differently exposed to schooling supply the year they turn 16 years old. We estimate the following model separately for each of the tracks of secondary education (e.g. general track or a specific vocational track):

$$Y_{imt} = \beta D_{mt} + \gamma_m + \lambda_t + (X'_{imt}\delta + \theta_{mt}) + \varepsilon_{imt} \quad (2)$$

where Y_{imt} is the outcome (e.g. enrolled in general track at age 16, completed a secondary degree by age 19) for individual i belonging to the cohort of 16-year-olds in municipality m in year t. The treatment indicator D_{mt} equals one for individuals in the treatment municipalities for the given track in the post-treatment periods, and zero otherwise. For our baseline estimation, treated municipalities include municipalities in the drop break group for the given field, and post-treatment period denotes the years after the structural break. Young people in the munici-

palities in the flat break group in the field are used to control for general trends in educational outcomes. β is the parameter of interest that captures the effect of the drop in schooling supply on educational outcomes. γ_m is municipality fixed effects and λ_t year fixed effects. Standard errors, ε_{imt}, are clustered at the municipality level, i.e. the level of aggregation at which the treatment occurs. Goodman-Bacon (2018) discusses the estimation of DD when treatment timing varies. The paper shows that the DD model in Equation 2 provides a two-way fixed effects DD estimator that is a weighted average of all possible 2x2 DD estimators comparing timing groups to each other.

For robustness, we add covariates to the specification. The covariate vector X_{imt} includes individual-level characteristics, as well as the time-varying municipality-level variables listed in Tables 2 and 3. As an alternative check on our DD strategy, we include municipality-specific time trends θ_{mt}, which allow schooling choices and educational outcomes to follow different trends across regions.

We also explore a specification including lags (post-treatment effects) and leads (anticipatory effects) of the treatment. This event study style of analysis allows the causal effect to grow or fade as time passes. Moreover, the leads serve as a useful check on our identification strategy. If supply breaks affect educational outcomes and not vice versa, then leads should not matter. We discuss the plausibility of our research design in more detail in Section 6.1, where we show evidence suggesting that the structural breaks are driven by exogenous pressure for school consolidations rather than sharp changes in underlying factors that determine educational and labor market outcomes.

5 Main results

To estimate the causal effects of access to post-compulsory education, we employ difference-in-differences and event study strategies that exploit variation in education supply across municipalities and over time. Our treatment group consists of individuals living in municipalities that experience a substantial reduction in the supply of the given education track between the years 2003-2009 (i.e. municipalities in the drop group). The control group includes those living in municipalities where the education supply was relatively stable during the observation period (i.e. municipalities in the flat group).

We focus on the effects of access to the three most prevalent secondary education tracks: general education, and the vocational fields of technology and services. In order to provide a better understanding of the importance of the regional availability of different secondary education fields, we perform the analysis separately for each of the education tracks studied.

5.1 Reduction in access to general education

Panel A in Table 4 reports the DD estimates for the effects of reducing general education supply on initial enrollment choices at 16 years, as well as on education and labor market outcomes measured up to five years later. First, the results show that the supply reductions affect the sorting of individuals across education tracks. Due to a drop in the supply of general education, individuals are 2.8 percentage points less likely to enroll in the general track, and 2.0 percentage points more likely to enroll in vocational education. These effects correspond to approximately a 5 percent change in the choice probabilities when compared to the averages in the treatment municipalities before the drop in supply.

However, the supply reductions do not appear to affect the probability of en-

rolling in any secondary school (column 3). The results for secondary education degree at the ages of 19 and 20 provide further evidence that reducing the supply of general education does not postpone graduation or decrease the likelihood of completing a secondary education degree. We also find that access to general education does not affect the mobility of individuals, i.e. the likelihood of enrolling in one's home municipality at the age of 16 (conditional on enrollment), or living there at the age of 21. Finally, the results in the latter three columns show that reductions in general education supply increase the likelihood of being employed at the age of 21, but have no effect on higher education enrollment or NEET status at the same age.

Figure 6 supplements these results with an event-study-style analysis reporting the effect for each year relative to the estimated structural break year. Panel A plots the results for enrollment outcomes measured at the age of 16 and panel B for outcomes measured three to five years later. The event study analysis confirms the above findings that a reduction in general education supply mainly affects the choice between general and vocational education. The graphs also provide evidence that the trends before the estimated break are similar. However, it appears that the effect on the sorting of individuals between the general and vocational tracks occurs already at the time of the break, instead of at the time of the drop in supply which takes place approximately a year later. This suggests that there are some anticipatory effects, and the last cohort before the drop in the number of available schooling positions is also affected by the upcoming change. Interestingly the effect is stable across the years after the negative break, e.g. the point estimate for enrolling in the general track is roughly around 3 percentage points throughout the post-treatment years.

Our results are in line with prior literature (e.g. Kelchtermans and Verboven,

2010a,b) that suggests that the decision of what to study (i.e. intensive margin) is more sensitive to the regional availability of education than the choice of whether to participate in education at all (i.e. extensive margin). The estimated positive effect of general education supply cuts on employment at the age of 21 years implies that there may also be some consequences for labor market trajectories. Unfortunately, our follow-up period does not allow us to examine how the shift from general to vocational education affects labor market performance in the longer run. A common finding in prior literature is that vocational education leads to better labor market outcomes at early stages of a career, whereas there is more contradiction involved with the long-run effects (e.g. Hall, 2016; Hanushek et al., 2017). Recent work by Silliman and Virtanen (2019) uses admission cutoffs to secondary schools in Finland and shows that for the marginal applicant, vocational education may have positive effects on labor market performance also later in careers (compared to the general track). It is impossible to know, however, whether or not the same applies to those whose schooling choices are affected by regional availability.

5.2 Reduction in access to vocational education

Panels B and C in Table 4 present the DD results for reduction in access to technology and services education, respectively. First, we see that reducing the regional availability of either of the two vocational fields significantly affects the choice of where to study (column 4). Supply reductions in the technology track decrease the probability of enrolling in one's home municipality by 10 percentage points (20%), whereas a drop in the supply of the services field leads to a 6 percentage point (10%) reduction in the probability of enrolling in the home municipality. This finding may also help to explain why individuals living in municipalities

that experience a reduction in the availability of the technology track are 6 percentage points (12%) less likely to enroll in general education, and 4 percentage points (10%) more likely to enroll in vocational education. If supply cuts increase the likelihood of applying somewhere further away, they may also influence the choice set of education alternatives, and thus affect education choices in unpredictable ways.

Moreover, we find that a drop in the supply of vocational tracks, quite surprisingly, decreases the probability of enrolling in higher education by 2 to 3 percentage points (6 to 8%). This also holds for the field of services, even though here we do not find a clear shift towards vocational secondary education.

Lovén et al. (2020) study university choices in Sweden and argue that studies at a university further away from home increase the mobility of individuals compared to studies at a local university close to home. According to our results on the likelihood of still living in the home municipality at the age of 21 years, this mechanism does not appear to be relevant in the context of post-compulsory studies in Finland, i.e. increased mobility at the age of 16 does not affect later migration decisions.

In line with our results on the effect of reducing access to general education, vocational education supply cuts do not affect participation in secondary education at age 16 (column 3). However, reducing the supply of vocational education has a significant effect on the probability of completing a secondary degree. Access to the field of technology appears to mainly postpone graduation, as the likelihood of graduating in the target duration by the age of 19 is 3 percentage points (4%) lower for the cohorts exposed to a drop in the supply of technology education, but we find no effect on the probability of graduating by the age of 20. Instead, reducing the availability of the services track reduces the likelihood of

completing any secondary degree by the age of 20 by almost 3 percentage points (4%). This result, together with the decreased likelihood of enrolling in higher education, implies that the supply of service education may have a substantial effect on overall educational attainment. A possibly equally alarming finding is that reducing the supply of the technology track increases the likelihood on being in NEET at the age of 21 by a little less than 2 percentage points (10%).

Figures 7 and 8 supplement our DD results with an event-study analysis. These results show that the timing of the supply reductions coincides quite nicely with the effects on schooling choices and outcomes. However, some of the estimated effects appear to be driven mainly by the later cohorts. Since we do not find significant changes in the characteristics of the individuals living in the treatment and control municipalities, and, more importantly, find similar results when defining the home municipality based on the municipality at birth (Table A9), we interpret these as causal effects of the drop in supply.

Together, our findings stress the importance of the supply of vocational education in preventing dropping out of school. Indeed, prior research suggests that vocational education may be a particularly important education alternative for those with lower prior school performance (e.g. Hall, 2016; Silliman and Virtanen, 2019), and that these individuals are also those typically most sensitive to distance-related costs (e.g. Falch et al., 2013; Dickerson and McIntosh, 2013). Finally, our results do not provide clear evidence that reductions in supply would affect migration decisions, and thus school consolidations may indeed lead to unequal distribution of human capital across regions.

5.3 Heterogeneity by gender and mother's education

According to prior literature, there may be significant differences in sensitivity to the regional availability of education between individuals (e.g. Falch et al., 2013; Dickerson and McIntosh, 2013; Gibbons and Vignoles, 2009). We explore heterogeneity in the effects by gender and by mother's education level.[15] These characteristics are typically at least strongly correlated with education choices, and thus the sub-groups may also react to supply reductions differently.

Panel A in Table 5 reports the estimated effects of reducing general education supply from a specification that adds a female dummy and its interaction term with the post-treatment dummy (D_{mt}) into our main specification. Panel A in Tables A2 and A3 in the appendix shows the findings from the corresponding estimations for the effects of reducing the availability of the technology and services tracks, respectively.

In general, we find that the initial enrollment choices of men are more affected by supply cuts than those of women. In particular, our results suggest that reducing access to any of the three secondary fields leads to a higher likelihood of men studying outside of their home municipality. Moreover, a drop in the supply of service education decreases the likelihood of men enrolling in any secondary track at the age of 16, and in higher education at the age of 21. In addition to these results, we find that the outcomes measured in the early twenties appear to show women reacting to reductions in supply at least as much as men.

Although these differences are not statistically significant, our estimates also suggest that reducing the regional availability of secondary education shifts men in particular from general education to vocational education. Since women are

[15] Our research data does not allow us to study heterogeneity by prior school performance. The only achievement measure we have, namely final grades from compulsory schooling (GPA), may also be affected by changes in post-compulsory education supply, and thus they are not exogenous to supply reductions.

also generally more inclined to follow the general education path, these changes have the potential to further widen gender gaps in education.

Panel B in Table 5 reports the effects of reducing the supply of general education from a specification that adds a dummy for mother having no post-compulsory education and its interaction term into the main specification. Tables A2 and A3 show the corresponding results for the vocational fields of technology and services. According to the results, reducing general education affects mainly the choice of what to study for those with more educated mothers, whereas it is the choice of where to study for those with less-educated mothers that is more affected by a drop in supply. The supply of vocational education appears to be clearly more important for those with less-educated mothers. In particular, reducing the regional availability of the technology track may have a detrimental effect on the labor market participation of those whose mothers have no post-compulsory education.

Our findings reveal substantial heterogeneity in sensitivity to supply cuts by both gender and parental background. The majority of these reductions will only increase pre-existing differences in human capital between these sub-populations.

6 Validity of research design and robustness

6.1 Validity of research design

Our empirical strategy is motivated by the exogenous pressure for school consolidations that leads to reductions in supply in some regions. Our assumption is that the timing and size of the structural break is orthogonal to other latent factors that drive schooling choices and outcomes. To assess the plausibility of this assumption, we perform various checks.

The descriptive statistics in Section 4.1 already showed that the municipalities in the different break groups look quite similar. To further examine the association between municipal characteristics and the estimated structural break, we run linear regressions, where we first explore how municipality-level characteristics are associated with the treatment status of the municipality (column 1 in Table A4). The regression includes the municipalities in the drop and flat break groups, and the dependent variable receives the value of one if the municipality belongs to the drop group for at least one of the three education fields. The results show that the municipalities in the drop group are smaller than the municipalities in the flat group. Otherwise these descriptive statistics are quite similar across break groups.

The rest of the columns in Table A4 examine how the regional characteristics correlate with the probability of a negative structural break occurring in a given year. Here we focus on the drop municipalities and use the municipality-year observations for the years 2002-2008 (the years of the possible maximum breaks). According to the results, the timing of the break is not associated with the municipality characteristics from the previous year, or with the trend in the characteristics in the prior two years.

Figure 9 explores the time profiles of the mean municipality-level characteristics in the break groups for the general track (see Figures A1 and A2 for the trends in the break groups of the technology and services fields, respectively). Panel A reports the averages of parental characteristics in the municipalities in each break group, and panel B other municipal variables such as size of the population and mean income in the municipality. In line with the mean statistics in Table 2, these figures show that the municipalities in the flat group are on average larger and have wealthier inhabitants.

However, what is more important is that the trends of the background variables across municipalities in the break groups appear to be quite similar and stable both before and after the structural break (as also suggested by the OLS regressions in Table A4). Only the patterns for the share of mothers in NEET differ, conveying a more favorable trend for the municipalities in the flat break group. Similarly, the time profiles for schooling choices and outcomes in Figure 10 indicate that the pre-treatment trends for our outcome variables evolve relatively smoothly.[16]

Figure A5 plots the relationship between the size of a municipality's structural break and its characteristics, such as the number of 16-year-olds, lagged employment rate, and characteristics of the parents. The figure shows that the structural break for the supply of the general track does not systematically correlate with any of the municipality-level variables. Similarly, we find that the magnitude of the structural break for the fields of technology and services exhibits no association with key pre-existing observable variables (Figure A6 and Figure A7). Moreover, our results are not very sensitive to adding controls to our baseline specification (Table A5).

Finally, we re-run the estimations by defining the municipality of residence based on the municipality of birth rather than the municipality of residence at age 15. This avoids another potential selection bias stemming from local developments affecting both families' migration decisions and educational outcomes. Our results are robust to such change (in Table A9).

Together, this evidence suggests that the structural breaks are indeed driven by exogenous pressure for school consolidations rather than capturing sharp changes in the underlying factors that determine educational and labor market outcomes.

[16]The corresponding time profiles for the fields of technology and services are presented in Figures A3 and A4.

6.2 Robustness

We perform several tests to explore the robustness of our results. Tables A5, A6, and A7 report results from estimations adding a rich set of individual, parental, and municipal characteristics as well as municipal trends to our baseline specification. The estimates are quite stable across the alternative specifications. However, adding municipal trends causes a few differences, particularly for the estimated effects of cuts in the supply of general education. This is line with the event study analysis in Section 5.1, where we showed that there is an anticipatory effect from reducing general education supply.

As noted in Section 4.1, urban municipalities are over-represented in the flat break groups, whereas there are no urban municipalities in the drop group for the two vocational fields. The variable is defined for the year 2015, and thus may not be a very informative characterization of the municipalities during the supply reductions. Nevertheless, we re-run our analysis with a sample excluding the urban municipalities altogether. These results, presented in Table A8, highlight the importance of the vocational field of technology for overall educational attainment (instead of the field of services, as suggested by our main analysis). Otherwise the findings for the sample without "urban municipalities" are quite similar to those for our main specification.

For our baseline specification, we allocate individuals to different break groups according to their municipality of residence at the age of 15 years. However, families might react to supply reductions, and thus we might worry about selection into staying and leaving.[17] To take this potential selection bias into account, we use the municipality at birth in defining the home municipality (and access to secondary education supply). As shown in Table A9, the results are very robust to

[17] Around 67 percent of the individuals in the drop group and 64 percent in the flat group live in their birth municipality at the age of 15 years

the definition of home municipality.

Next, we examine the sensitivity of our results to the definition of treatment and control municipalities. First, we use the same structural breaks method, but use a cutoff of -.2 instead of -.1 to divide the municipalities into the drop and flat break groups (Table A10). Secondly, we define the treatment and control municipalities simply based on the year-to-year change in schooling positions per cohort (Table A11). Here, the treatment municipalities include those that experience a drop of 50 percent or more in the supply of a given track.[18] For the control group, we include municipalities that have a stable supply in the given track.[19] We use the same analysis years as in our main specification, i.e. the drop occurs in the years 2003-2009 and includes the 16-year-olds living in these municipalities for five years before and after the drop. The results for the effects of a drop in the supply of general and technology education are very robust to using the alternative definitions of the treatment and control groups. As is also the case for some of the other robustness checks, the estimated effect of reducing the regional availability of the services track is more sensitive to the alterations.

Finally, we explore the robustness of our results to the period studied. School closures became increasingly common in the second decade of the 21st century. By examining the later years, we can check that the estimated effects are not a special characteristic of earlier school closures. Moreover, some of the pre-treatment years used in our main analysis overlap with the roll-out period of a vocational education reform (see Section 2). To confirm that these changes in educational institutions do not affect the estimated effect of the supply reductions, we repeat

[18] More specifically, the drop group includes municipalities that supplied education in the given field for at least three years before the drop. Moreover, the supply needs to drop by 50 percent or more compared to the previous year and to the mean of three previous years, and needs to remain at the lower level for at least the following two years.

[19] We exclude municipalities where the supply (measured in 3-year-averages) fluctuates over 20 percent up or down between any two consecutive 3-year averages.

the analysis excluding the overlapping years. Table A12 reports the results for estimations where we include the maximum breaks between the years 2007 and 2013. We are able to use the set-up with the additional years only for a subset of our outcomes, namely those measured at the age 16 years. We can see that even when using a dramatically different sample, we get very similar results.

7 Conclusions

Policy makers around the world have bought about structural changes in educational supply by reforming school networks. Shrinking cohort sizes and constricting budgets further increase pressure to close smaller schools and establish larger education units. Even though school consolidations may provide an appealing way to restrain education expenditure, they may also have undesirable consequences for the educational choices of local youth. This is particularly the case in post-compulsory education, where reducing the regional availability of education may even encourage some to drop out of school altogether.

Our paper contributes to the scarce literature studying the impact of closing post-compulsory schools by exploiting exogenous variation in the timing of supply reductions across regions in Finland. We exploit a structural breaks method in determining sharp changes in the supply of secondary schooling at the municipality-field level. Our treatment group consists of individuals living in municipalities that experience a substantial reduction (i.e. municipalities in the drop group) in the supply of the given education track between the years 2003-2009. The control group includes those living in municipalities where the education supply was relatively stable in the observation period (i.e. municipalities in the flat group). We use both difference-in-differences and event study strategies and estimate the effects of supply reductions separately for the three most prevalent secondary ed-

ucation tracks, namely general education and the vocational fields of technology and services.

Our results show that access to post-compulsory education has substantial effects on the enrollment choices of 16-year-olds, and that these effects vary by education track. We find that reducing the supply of general secondary education mainly affects the sorting of individuals between general and vocational education. The regional availability of the vocational fields of technology and services also has a large impact on the choice of where to study. This increased student mobility makes predicting changes in student responses very difficult. In fact, we find that reducing access to the technology track also shifts individuals from general education into vocational education.

According to our findings, reducing regional access to vocational education at least postpones graduation, and may also have long-term effects on educational attainment. Additionally, our results show that the initial enrollment choices of men are more sensitive to supply reductions than those of women, and that the field of technology is particularly important for individuals with less-educated mothers.

Finally, our results suggest that school consolidations may have a substantial impact on labor market trajectories. Unfortunately, our data allows us to follow educational and labor market outcomes only until the early twenties. An important question for future research is the extent to which changes in enrollment patterns and initial labor market performance transmit to labor market careers in the long run. Moreover, the consequences for regional inequalities and differences in the skill composition between regions should be studied in detail to get a better understanding of the potential welfare losses of increasingly common school consolidations.

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8 Tables and Figures

Table 1: Distribution of applications across education fields

	Total	Men	Women	Mother with no post-compulsory education	Mother with post-compulsory education
General education	57.50	49.66	65.36	40.98	60.65
Vocational education	42.50	50.34	34.64	59.02	39.35
Educational Science	0.34	0.02	0.80	0.29	0.35
Arts and Humanities	4.98	2.91	7.98	4.07	5.24
Business and Social Sciences	13.34	13.03	13.78	12.68	13.52
Technology	47.26	71.32	12.26	46.55	47.46
Agriculture and Forestry	4.45	3.88	5.27	4.01	4.57
Health and Welfare	10.14	1.68	22.46	9.61	10.29
Services	19.50	7.15	37.45	22.79	18.55
Observations	1106354	565147	541207	198220	908134

Notes: This table reports the share of 1st ranked applications to each track for total data, and for sub-samples divided based on gender and mother's education for individuals turning 16 years old in the years 1997-2013. The distribution of applications across vocational fields is reported conditional on listing a vocational track as the first request.

Table 2: Descriptive statistics for total data and the break groups: Individual and parental characteristics

	All	General			Technology			Services		
		Drop	Flat	Growth	Drop	Flat	Growth	Drop	Flat	Growth
GPA	7.62	7.62	7.69	7.56	7.54	7.64	7.59	7.54	7.58	7.52
	(1.12)	(1.10)	(1.12)	(1.12)	(1.11)	(1.09)	(1.11)	(1.11)	(1.10)	(1.11)
Male	0.511	0.511	0.508	0.514	0.510	0.508	0.510	0.513	0.513	0.509
	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)
Native language Finnish	0.915	0.828	0.934	0.874	0.903	0.938	0.959	0.987	0.914	0.990
	(0.279)	(0.378)	(0.248)	(0.332)	(0.295)	(0.241)	(0.199)	(0.114)	(0.281)	(0.101)
Native language Swedish	0.054	0.155	0.034	0.107	0.083	0.040	0.014	0.002	0.065	0.001
	(0.226)	(0.362)	(0.182)	(0.309)	(0.277)	(0.196)	(0.117)	(0.043)	(0.246)	(0.032)
Native language not Finnish or Swedish	0.031	0.018	0.032	0.019	0.013	0.022	0.027	0.011	0.022	0.009
	(0.174)	(0.133)	(0.175)	(0.136)	(0.114)	(0.146)	(0.163)	(0.106)	(0.145)	(0.096)
Father's income	40360	41081	46286	36093	33936	41948	37588	31087	40536	37758
	(63263)	(107004)	(85001)	(26075)	(24521)	(80930)	(29549)	(22836)	(38641)	(29595)
Father in NEET	0.154	0.151	0.148	0.149	0.165	0.147	0.162	0.185	0.148	0.149
	(0.361)	(0.358)	(0.355)	(0.356)	(0.371)	(0.354)	(0.369)	(0.388)	(0.355)	(0.356)
Father with post-compulsory degree	0.727	0.736	0.755	0.722	0.731	0.744	0.743	0.708	0.738	0.752
	(0.446)	(0.441)	(0.430)	(0.448)	(0.443)	(0.436)	(0.437)	(0.455)	(0.439)	(0.432)
Father with HE degree	0.317	0.316	0.386	0.262	0.254	0.339	0.306	0.211	0.307	0.257
	(0.465)	(0.465)	(0.487)	(0.440)	(0.436)	(0.473)	(0.461)	(0.408)	(0.461)	(0.437)
Mother's income	22288	21813	24218	19971	20504	23026	21087	19217	21766	20697
	(15662)	(14938)	(18337)	(12578)	(11935)	(16292)	(13434)	(11718)	(14562)	(11850)
Mother in NEET	0.158	0.156	0.150	0.170	0.149	0.142	0.172	0.184	0.163	0.158
	(0.365)	(0.363)	(0.357)	(0.376)	(0.356)	(0.349)	(0.378)	(0.388)	(0.370)	(0.365)
Mother with post-compulsory degree	0.821	0.834	0.840	0.827	0.829	0.838	0.838	0.815	0.829	0.846
	(0.383)	(0.373)	(0.367)	(0.378)	(0.377)	(0.368)	(0.369)	(0.389)	(0.376)	(0.361)
Mother with HE degree	0.399	0.407	0.458	0.368	0.344	0.418	0.397	0.299	0.391	0.353
	(0.490)	(0.491)	(0.498)	(0.482)	(0.475)	(0.493)	(0.489)	(0.458)	(0.488)	(0.478)
Observations	1106354	80520	190296	50498	16071	82478	228298	12975	86599	8546

Notes: This table reports mean background characteristics for total data, and for each break group for individuals turning 16 years old in the years 1997-2013. The three columns for any of the three education tracks do not add up to those in the "all" column. The track specific columns exclude observations from the municipalities that do not provide the given secondary education field between the years 2002-2008, experience their largest structural break before or after these years, or for which the estimated maximum negative structural break is below -1.0. Standard deviations reported in parenthesis.

Table 3: Descriptive statistics for total data and the break groups: Municipal-level characteristics

	All	General			Technology			Services		
		Drop	Flat	Growth	Drop	Flat	Growth	Drop	Flat	Growth
Population	17008	16321	55935	12181	10288	37900	34496	6756	24555	13637
	(42750)	(14742)	(58789)	(14155)	(4911)	(32607)	(36434)	(2102)	(18370)	(6406)
Share of 16-year-olds	0.014	0.014	0.013	0.014	0.014	0.014	0.013	0.013	0.014	0.013
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Unemployment rate (ages 25-64)	0.123	0.119	0.107	0.126	0.132	0.110	0.140	0.159	0.131	0.129
	(0.050)	(0.044)	(0.038)	(0.039)	(0.042)	(0.039)	(0.033)	(0.059)	(0.045)	(0.013)
Employment rate (ages 25-64)	0.694	0.707	0.731	0.682	0.678	0.726	0.676	0.648	0.693	0.693
	(0.071)	(0.065)	(0.055)	(0.058)	(0.059)	(0.064)	(0.047)	(0.077)	(0.067)	(0.015)
Income (ages 25-64)	25238	27966	29699	24080	24858	29403	25730	23172	27055	26616
	(4372)	(8208)	(4212)	(2802)	(2718)	(4840)	(2598)	(2688)	(4392)	(2114)
Share of urban municipalities	0.186	0.273	0.813	0.222	0.000	0.600	0.531	0.000	0.500	0.333
	(0.390)	(0.456)	(0.403)	(0.428)	(0.000)	(0.516)	(0.507)	(0.000)	(0.516)	(0.577)
Share of semiurban municipalities	0.209	0.364	0.125	0.333	0.429	0.400	0.313	0.333	0.313	0.667
	(0.407)	(0.492)	(0.342)	(0.485)	(0.535)	(0.516)	(0.471)	(0.500)	(0.479)	(0.577)
Share of rural municipalities	0.605	0.364	0.063	0.444	0.571	0.000	0.156	0.667	0.188	0.000
	(0.490)	(0.492)	(0.250)	(0.511)	(0.535)	(0.000)	(0.369)	(0.500)	(0.403)	(0.000)
Observations	311	22	16	18	7	10	32	9	16	3

Notes: This table reports municipality-level characteristics over the years 1997-2013 for total data, and for each break group. The three columns for any of the three education tracks do not add up to those in the "total" column. The track specific columns exclude observations from the municipalities that do not provide the given secondary education field between the years 2002-2008, experience their largest structural break before or after these years, or for which the estimated maximum negative structural break is below -1.0. Standard deviations reported in parenthesis.

Table 4: DD results for drop in post-compulsory education supply

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. DROP IN THE SUPPLY OF GENERAL TRACK										
Treatment effect	-0.028***	0.020**	-0.010	-0.021	-0.011	-0.010	-0.000	-0.003	0.019**	0.001
	(0.009)	(0.008)	(0.007)	(0.014)	(0.008)	(0.009)	(0.008)	(0.005)	(0.008)	(0.006)
Observations	173630	173630	173630	147453	173326	173502	173412	173326	170492	170492
Observations in treatment group	51217	51217	51217	44088	51129	51170	51146	51129	50360	50360
Mean in treatment municipalities before break	0.535	0.355	0.871	0.725	0.573	0.660	0.794	0.424	0.511	0.135
PANEL B. DROP IN THE SUPPLY OF TECHNOLOGY TRACK										
Treatment effect	-0.059***	0.039**	-0.020	-0.102***	-0.015	-0.028***	-0.008	-0.023**	-0.008	0.015**
	(0.018)	(0.017)	(0.014)	(0.026)	(0.015)	(0.008)	(0.010)	(0.010)	(0.014)	(0.006)
Observations	62735	62735	62735	52939	62609	62677	62642	62609	61775	61775
Observations in treatment group	10209	10209	10209	8780	10181	10196	10186	10181	10067	10067
Mean in treatment municipalities before break	0.488	0.384	0.869	0.520	0.471	0.704	0.811	0.395	0.542	0.138
PANEL C. DROP IN THE SUPPLY OF SERVICES TRACK										
Treatment effect	0.011	-0.018	-0.010	-0.064**	-0.013	-0.024	-0.035***	-0.030*	0.003	0.006
	(0.016)	(0.014)	(0.009)	(0.028)	(0.020)	(0.018)	(0.011)	(0.016)	(0.016)	(0.010)
Observations	63347	63347	63347	54397	63181	63272	63227	63181	62342	62342
Observations in treatment group	7979	7979	7979	6943	7940	7963	7950	7940	7866	7866
Mean in treatment municipalities before break	0.481	0.406	0.880	0.588	0.477	0.697	0.820	0.377	0.515	0.162

Notes: This table shows DD estimates of the effect of a drop in general, technology and services education supply on educational and labor market outcomes. The treatment effect variable is an interaction of a drop group dummy and an indicator of whether the year is after the estimated year of the structural break. The estimations use data from municipalities in the drop (estimated structural break between -0.1 and -1) and flat (estimated structural break between -0.1 and 0.1) groups. We focus on municipalities in which the estimated maximum break occurs between the years 2002 and 2008 (drop in supply occurs between the years 2003-2009). The information on whether students are enrolled in their home municipality at 16 is missing for year 1997, which corresponds to t=-5 for some of the municipalities, but the estimates are robust to specifications excluding t=-5. The outcome "Enrolled in home municipality at 16" is defined conditional on enrollment. The estimations use specification in Equation 2 which includes municipality and year fixed effects. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01. The corresponding event study-style analysis depicted in Figures 6, 7, and 8.

Table 5: Heterogeneity by gender and mother's education: General track

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. GENDER										
Treatment effect	-0.035**	0.022*	-0.014	-0.047**	-0.014	-0.005	0.005	-0.008	0.009	0.009
	(0.013)	(0.012)	(0.008)	(0.019)	(0.009)	(0.010)	(0.008)	(0.007)	(0.012)	(0.007)
Treatment*Female	0.016	-0.006	0.007	0.052***	0.005	-0.010	-0.011*	0.011	0.020	-0.017**
	(0.012)	(0.013)	(0.006)	(0.018)	(0.008)	(0.007)	(0.007)	(0.008)	(0.017)	(0.008)
Female	0.158***	-0.129***	0.030***	-0.053***	-0.141***	0.050***	0.049***	0.089***	0.066***	-0.044***
	(0.011)	(0.011)	(0.004)	(0.011)	(0.005)	(0.004)	(0.005)	(0.006)	(0.009)	(0.006)
Observations	173630	173630	173630	147453	173326	173502	173412	173326	170492	170492
Observations in treatment group	51217	51217	51217	44088	51129	51170	51146	51129	50360	50360
Mean in treatment municipalities before break	0.535	0.355	0.871	0.725	0.573	0.660	0.794	0.424	0.511	0.135
PANEL B. MOTHER'S EDUCATION										
Treatment effect	-0.031***	0.023**	-0.011	-0.016	-0.012	-0.010	-0.001	-0.005	0.022**	0.002
	(0.011)	(0.009)	(0.007)	(0.014)	(0.008)	(0.011)	(0.008)	(0.007)	(0.009)	(0.006)
Treatment*Mother with no post-compulsory education	0.019	-0.021	0.007	-0.048***	0.009	-0.003	0.001	0.015	-0.019	-0.005
	(0.020)	(0.019)	(0.021)	(0.017)	(0.014)	(0.018)	(0.021)	(0.020)	(0.012)	(0.010)
Mother with no post-compulsory education	-0.280***	0.117***	-0.161***	-0.046***	0.058***	-0.200***	-0.208***	-0.244***	-0.008	0.107***
	(0.018)	(0.009)	(0.016)	(0.012)	(0.005)	(0.016)	(0.017)	(0.018)	(0.010)	(0.007)
Observations	173630	173630	173630	147453	173326	173502	173412	173326	170492	170492
Observations in treatment group	51217	51217	51217	44088	51129	51170	51146	51129	50360	50360
Mean in treatment municipalities before break	0.535	0.355	0.871	0.725	0.573	0.660	0.794	0.424	0.511	0.135

Notes: This table shows DD estimates of the effect of drop in general education supply on educational and labor market outcomes with interactions with female dummy and mother's education dummy. Treatment effect variable is an interaction of drop group dummy and an indicator of whether the year is after the estimated year of structural break. Estimations use data from municipalities in drop (estimated structural break between -0.1 and -1) and flat (estimated structural break between -0.1 and 0.1) groups. We focus on municipalities in which the estimated maximum break occurs between the years 2002 and 2008 (drop in supply occurs between the years 2003-2009). The information on whether the student is enrolled in home municipality at 16 is missing for year 1997, which corresponds to t=-5 for some of the municipalities, but the estimates are robust to specifications excluding t=-5. Outcome "Enrolled in home municipality at 16" is defined conditional on enrollment. Specification includes municipality and year fixed effects. Standard errors (in parentheses) are clustered at municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

(a) General Secondary Schools **(b)** Vocational Secondary Schools

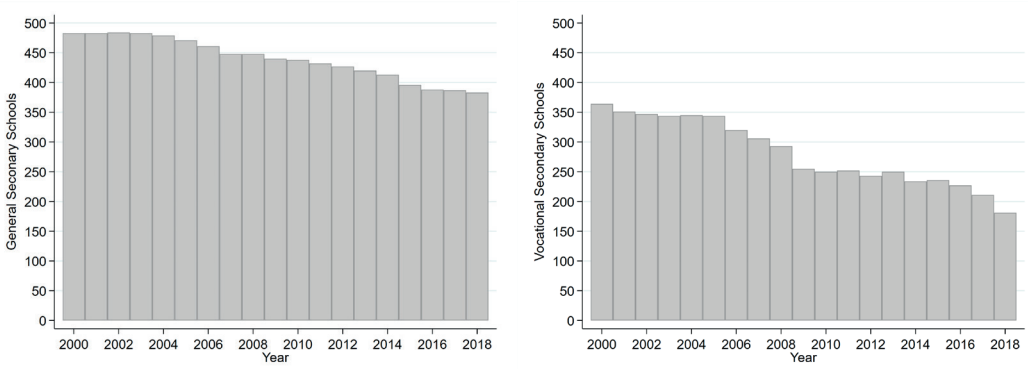

Figure 1: Number of secondary schools in Finland between the years 2000-2018

Notes: This figure shows the number of general and vocational secondary schools between the years 2000-2018 in Finland. Source: Vipunen (an online reporting portal maintained by the Ministry of Education and Culture and the Finnish National Agency for Education).

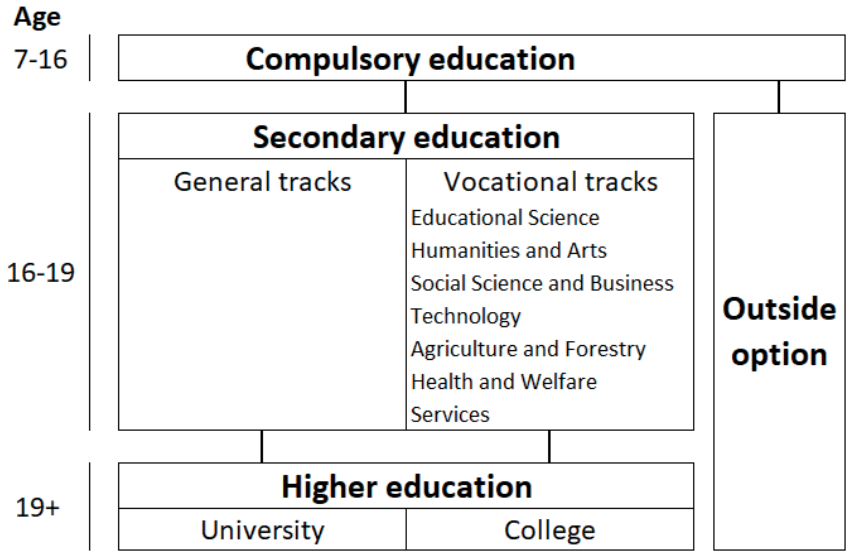

Figure 2: Finnish Education system

Notes: This figure shows the possible pathways through education from compulsory education through higher education. Figure is adapted from Silliman and Virtanen (2019).

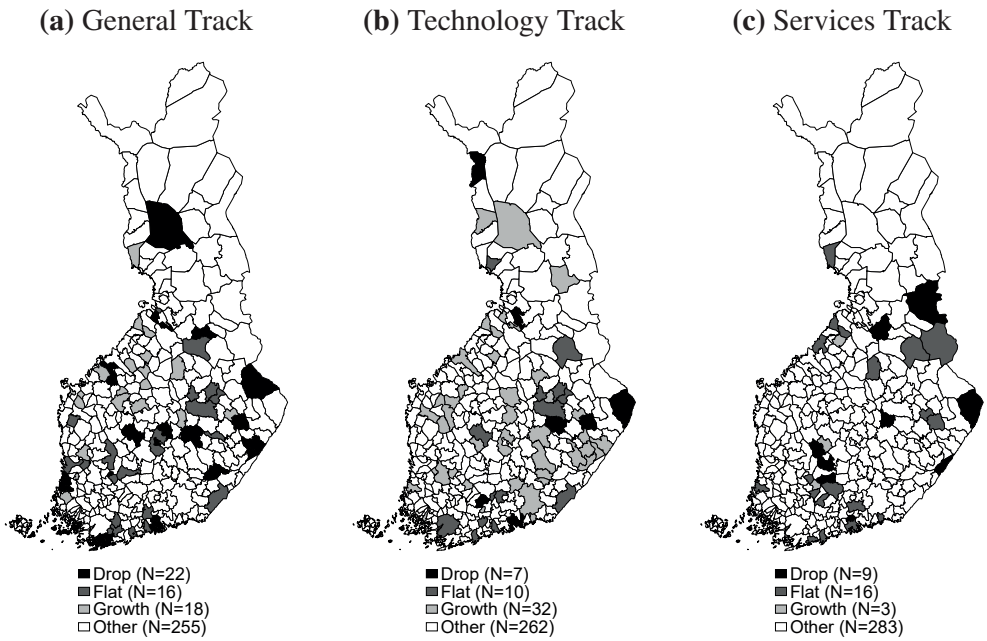

Figure 3: Geographical distribution of the break groups

Notes: This figure depicts the geographical distribution of the three break groups (drop, growth and flat) for the three education fields separately. We use a municipal classification for the year 2015.

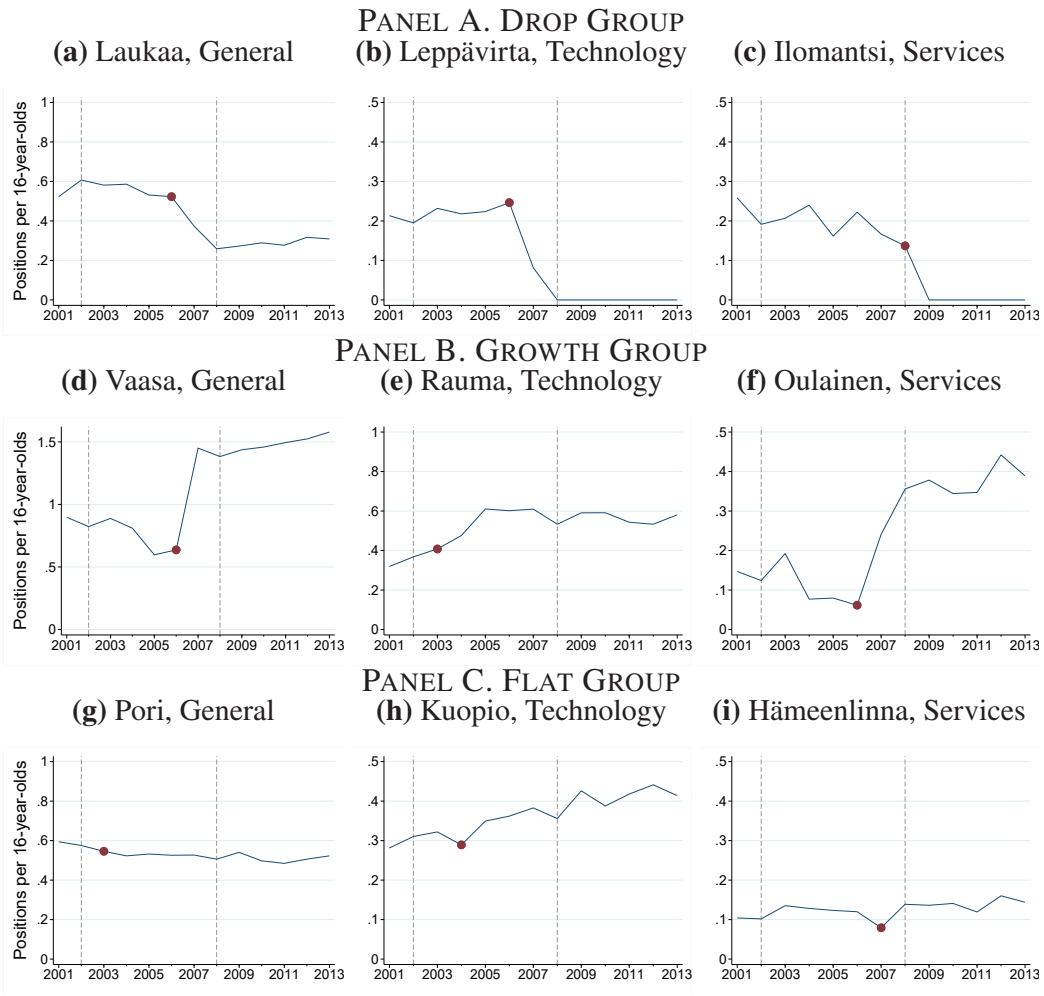

Figure 4: Supply trends and structural breaks across municipalities

Notes: This figure shows yearly schooling supply data for three fields (general, technology, and services) in nine municipalities. Schooling supply is defined based on schooling positions in a given field per the number of 16-years-olds in the municipality. The solid line reports the schooling supply with a solid dot indicating the estimated year of the structural break. Municipalities in the drop group have relatively large negative estimated breaks (between -0.1 and -1); the municipalities in the growth group have relatively large positive estimated breaks (between 0.1 and 1), and the municipalities in the flat group have small estimated structural breaks (between -0.1 and 0.1).

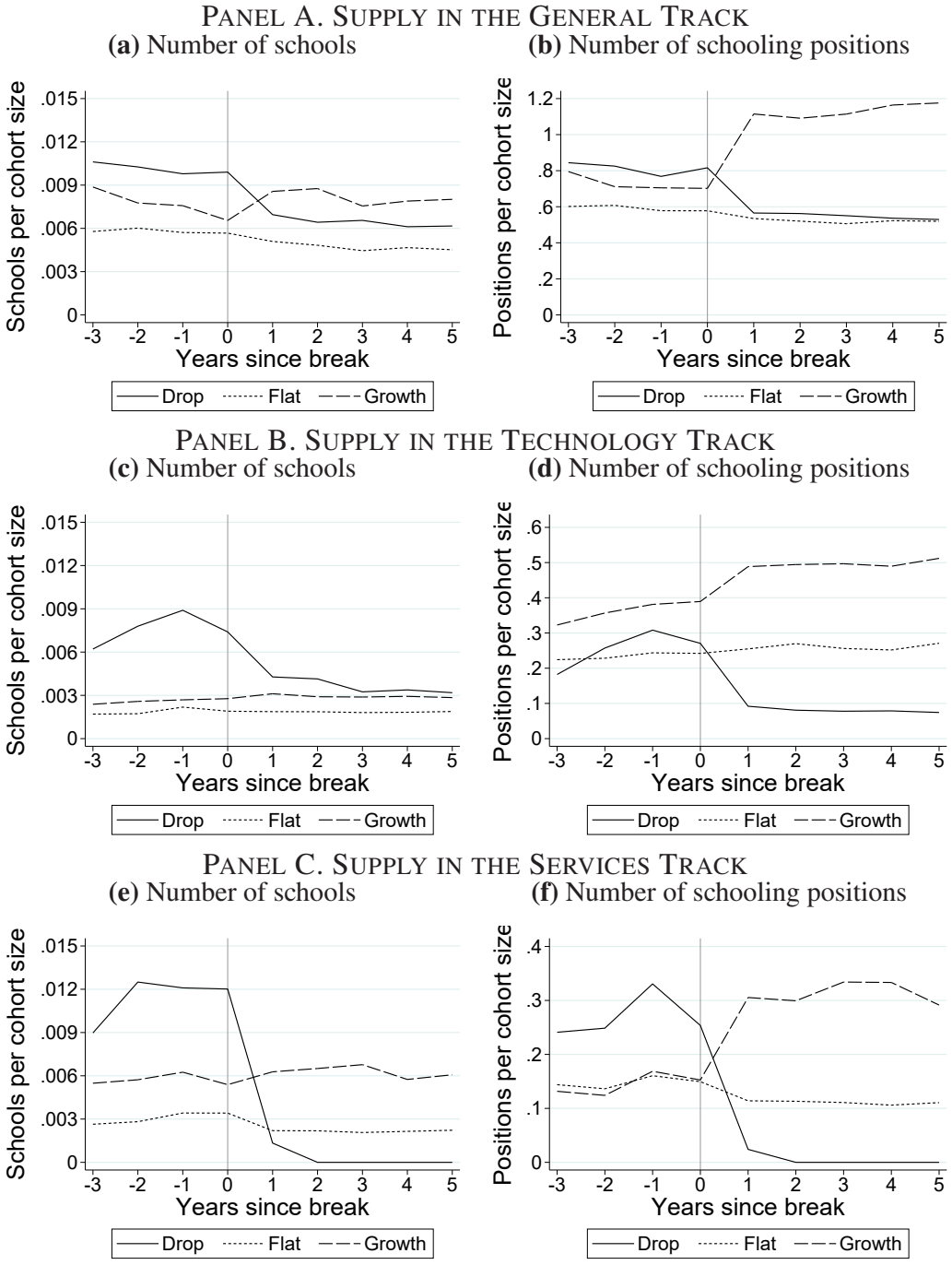

Figure 5: Education supply in the break groups before and after the structural break

Notes: This figure depicts the average number of schools and schooling positions in the given field per cohort separately for the municipalities in the three break groups (drop, growth and flat). The level of supply is shown for each year from three years before to five years since the break.

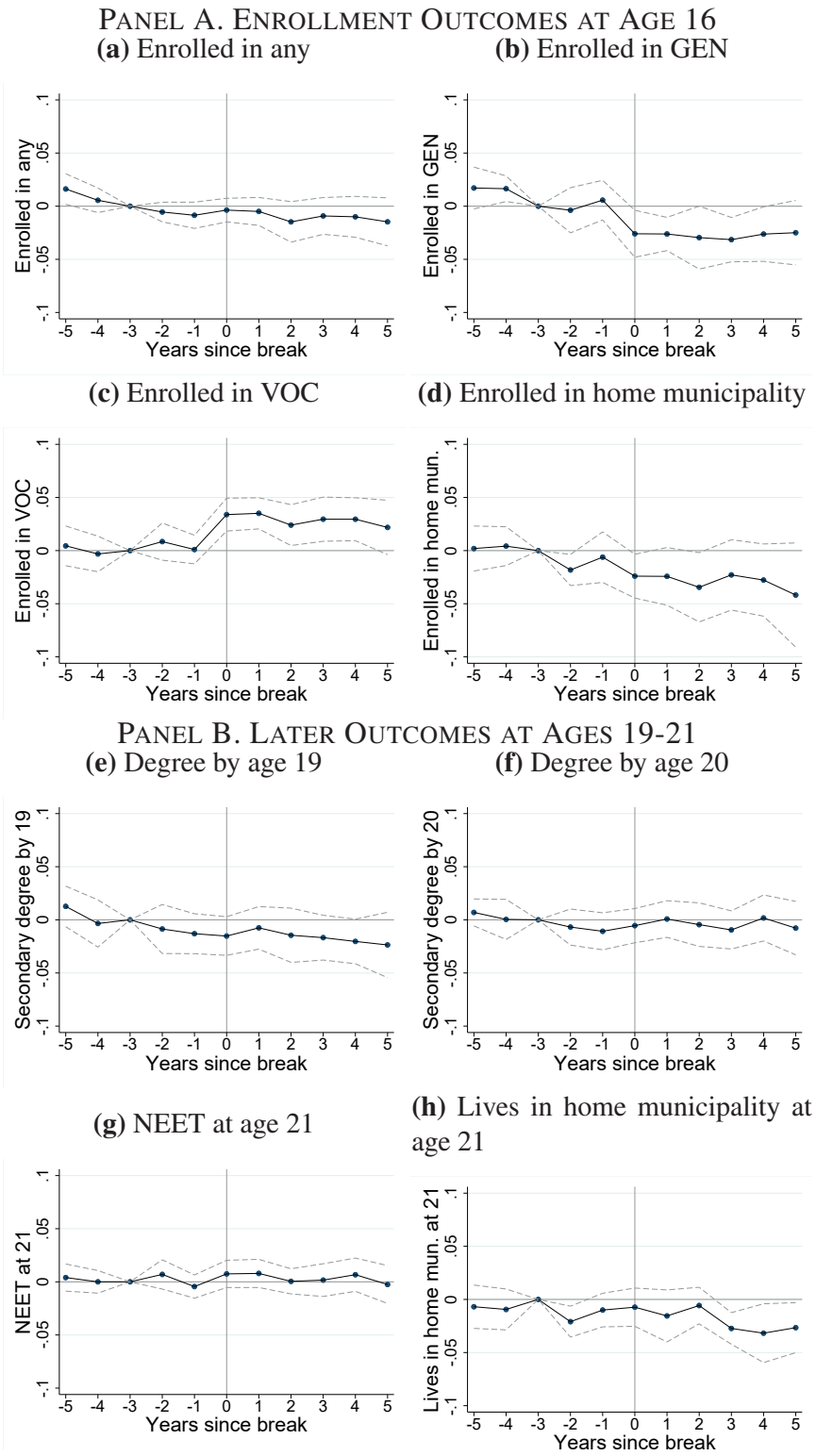

Figure 6: Event study analysis of drop in the supply of general track

Notes: This figure reports estimates of event study regressions which include an indicator variable for each year before and after the year of the estimated structural break. The event study regression specification includes year fixed effects and municipality fixed effects. We include municipalities in the drop and flat break groups, and focus on municipalities in which the estimated maximum break occurs between the years 2002 and 2008. Standard errors are clustered at the municipality level. The corresponding DD estimates reported in Table 4.

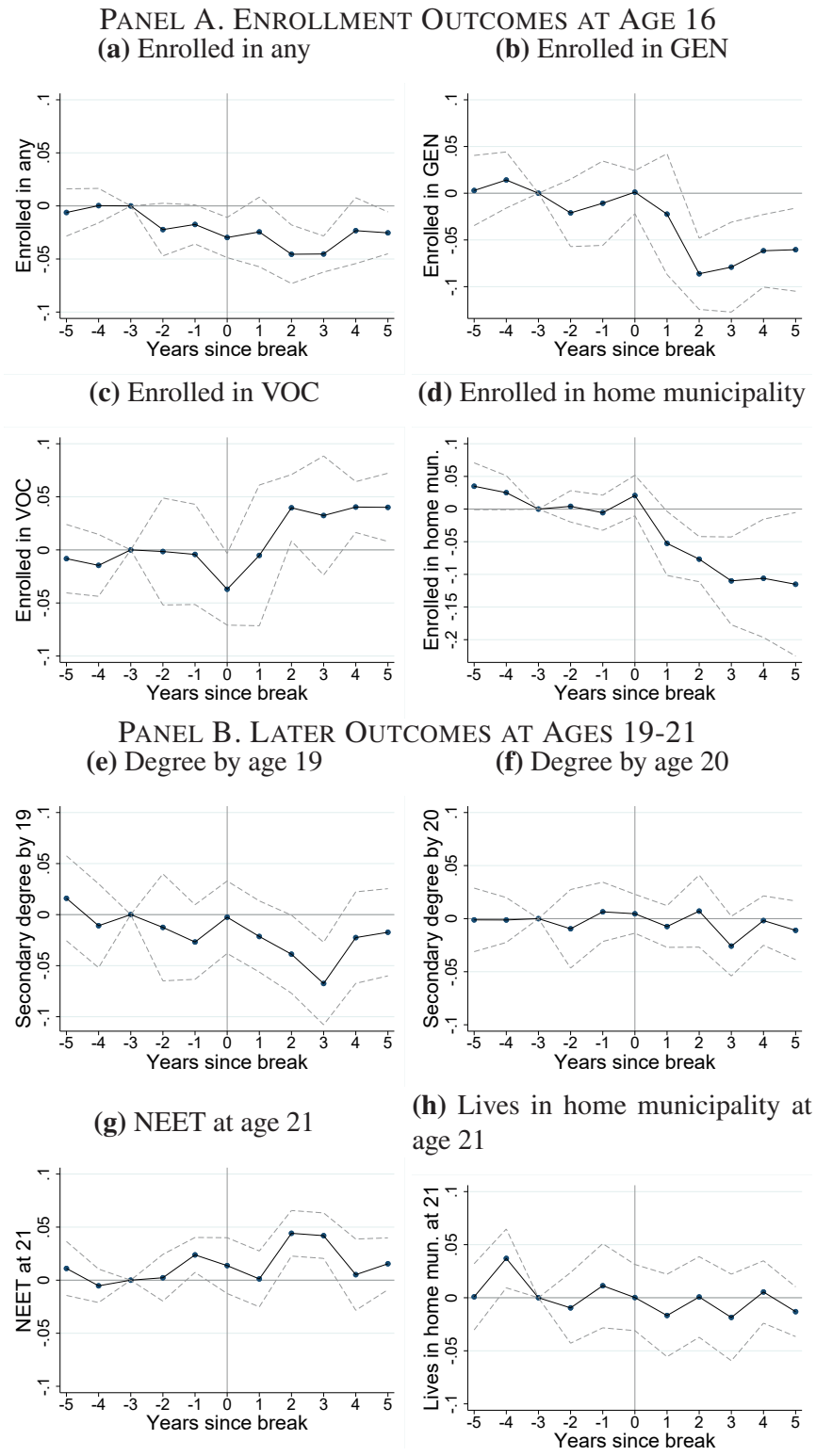

Figure 7: Event study analysis of drop in the supply of technology track

Notes: See figure notes in Figure 6.

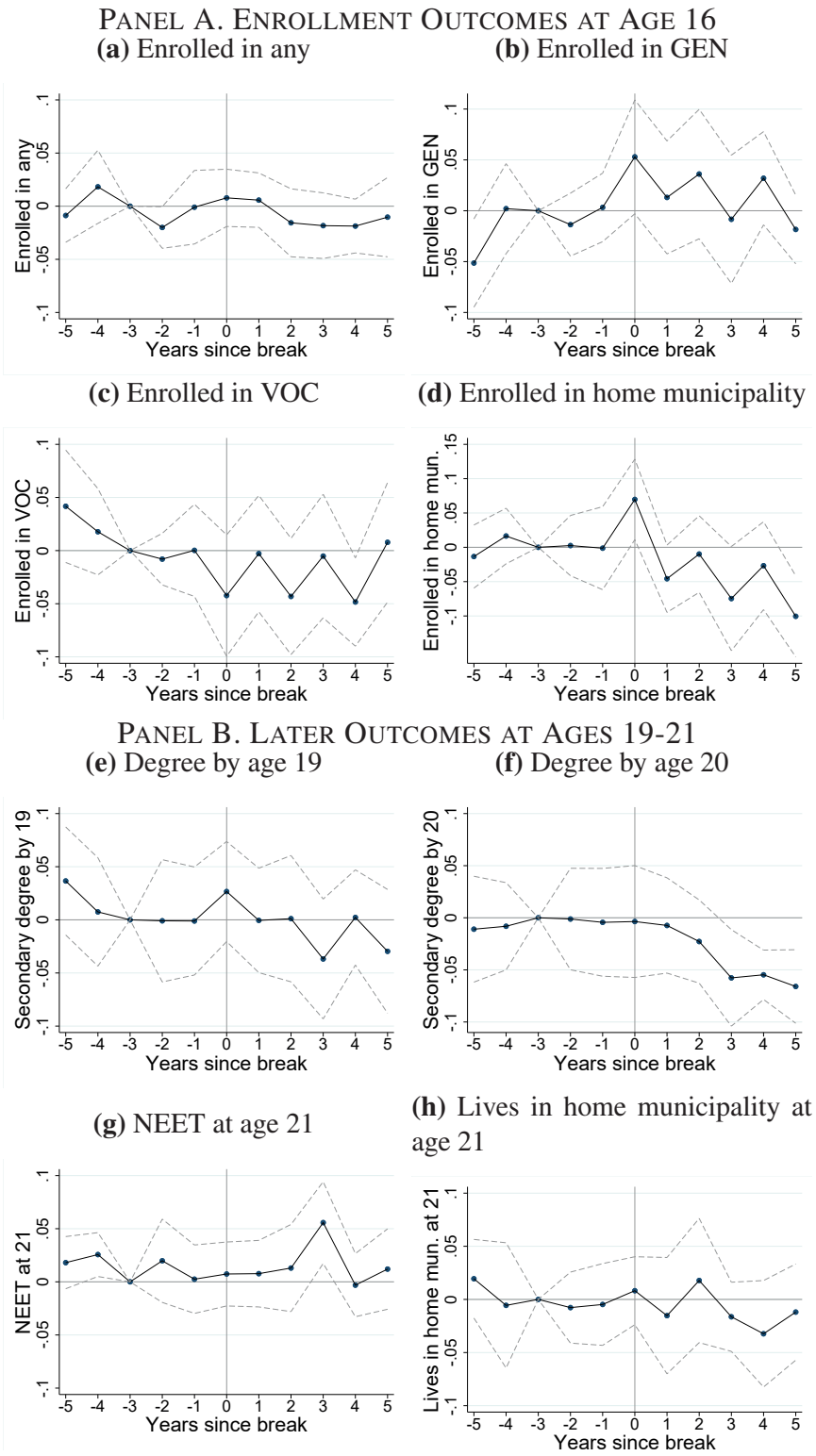

Figure 8: Event study analysis of drop in the supply of services track

Notes: See figure notes in Figure 6.

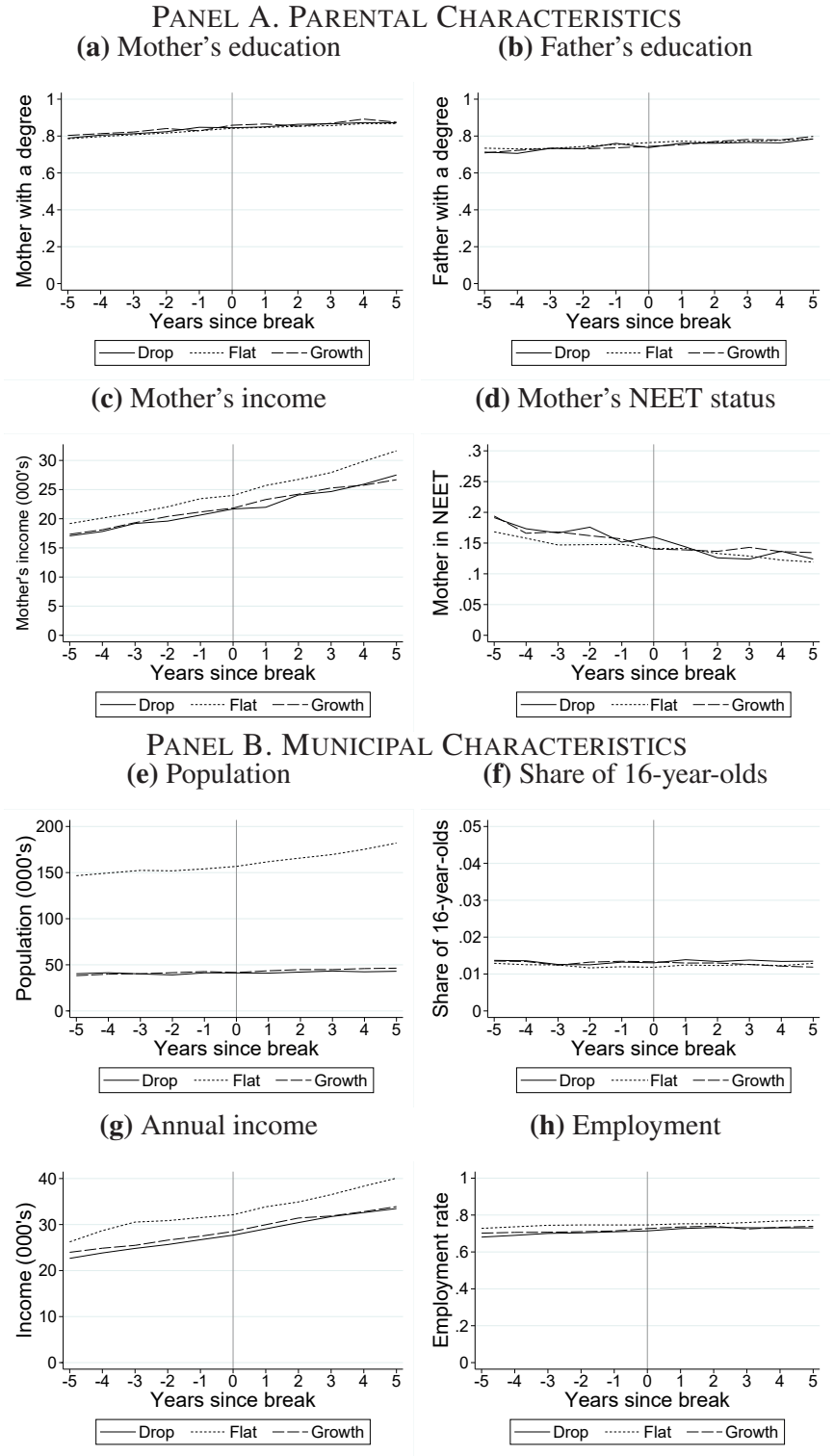

Figure 9: Covariates in the break groups before and after the break: general track

Notes: This figure depicts the mean parental characteristics, and the mean municipal characteristics for the municipalities in the three break groups (drop, growth and flat) each year from three years before to five years after the break. The municipal variables income and employment are calculated using the 25-64-year-olds living in the municipality.

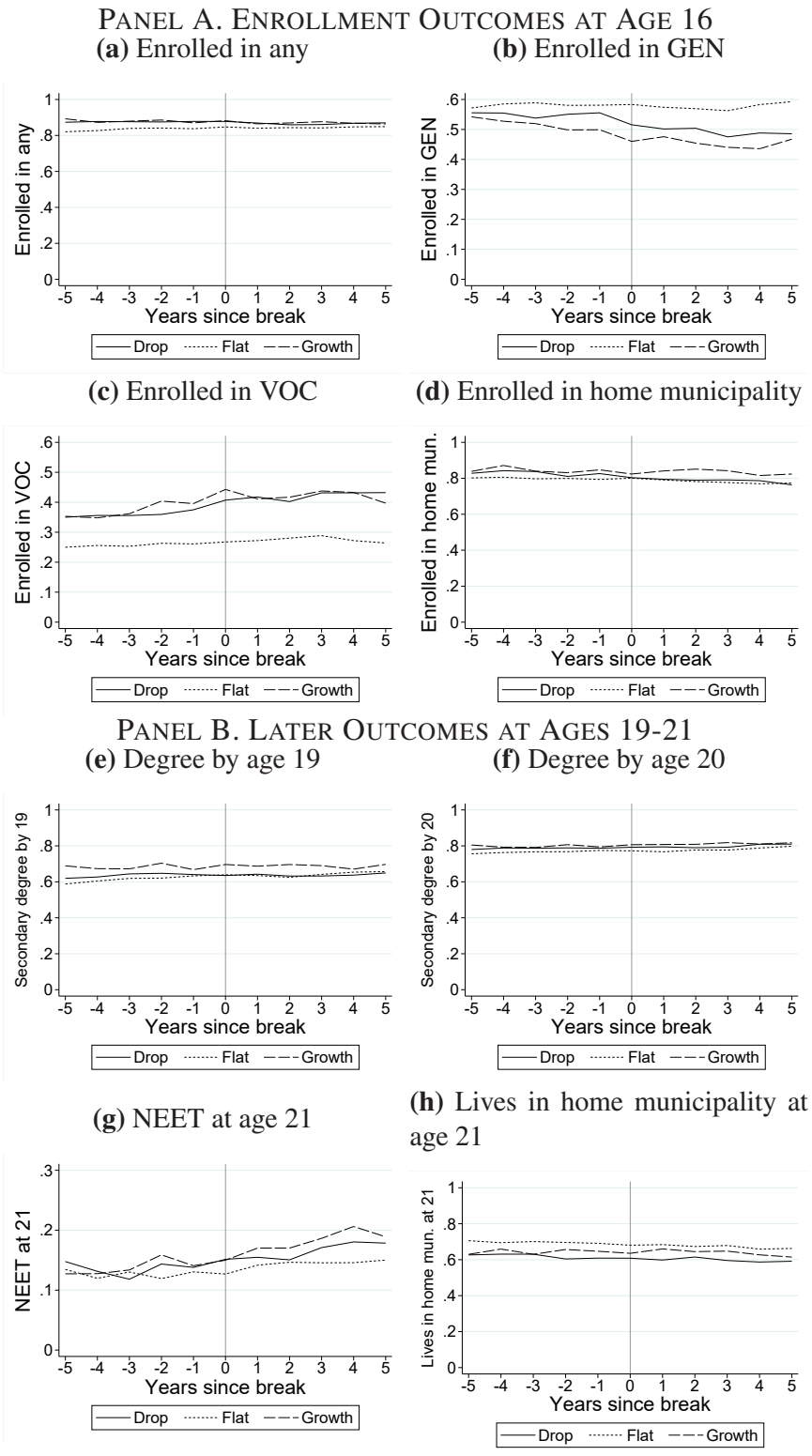

Figure 10: Outcomes in the break groups before and after the break: general track

Notes: This figure depicts the means for the outcome variables for the municipalities in the three break groups (drop, growth and flat) each year from three years before to five years after the break.

A Additional Tables and Figures

Table A1: List of municipalities with largest negative structural breaks for general, technology, and services tracks

Rank	Municipality	Number of 16-year-olds	Supply of schooling	Magnitude of the break	Break year
		PANEL A. GENERAL TRACK			
1	Puumala	30	0.50	-0.89	2008
2	Paltamo	49	1.55	-0.72	2007
3	Hanko	107	2.12	-0.67	2004
4	Liperi	186	0.39	-0.50	2005
5	Kauniainen	105	1.89	-0.43	2004
6	Raasepori	355	1.07	-0.40	2002
7	Parainen	183	1.23	-0.32	2003
8	Evijärvi	36	1.56	-0.30	2007
9	Kruunupyy	95	1.35	-0.28	2004
10	Liminka	87	0.74	-0.24	2002
11	Kitee	154	1.03	-0.23	2007
12	Laukaa	260	0.52	-0.21	2006
13	Eurajoki	113	0.86	-0.19	2007
14	Rauma	467	0.77	-0.17	2006
15	Keuruu	124	1.13	-0.17	2006
16	Porvoo	580	0.68	-0.16	2004
17	Lieksa	181	0.90	-0.14	2007
18	Askola	53	0.94	-0.12	2007
19	Pieksämäki	281	0.60	-0.12	2006
20	Pirkkala	197	0.46	-0.11	2005
21	Rovaniemi	793	0.55	-0.11	2005
22	Muurame	109	0.64	-0.10	2003
		PANEL B. TECHNOLOGY TRACK			
1	Ilomantsi	73	0.23	-0.30	2008
2	Leppävirta	138	0.25	-0.22	2006
3	Muonio	35	0.89	-0.17	2008
4	Liperi	171	0.14	-0.14	2003
5	Loviisa	173	0.52	-0.12	2007
6	Janakkala	223	0.13	-0.11	2006
7	Muhos	133	0.24	-0.10	2006
		PANEL C. SERVICES TRACK			
1	Ruovesi	63	1.27	-0.95	2007
2	Askola	76	0.24	-0.21	2006
3	Vaala	63	0.25	-0.21	2005
4	Ilomantsi	73	0.14	-0.16	2008
5	Pälkäne	78	0.10	-0.16	2003
6	Parikkala	73	0.22	-0.14	2004
7	Orivesi	127	0.14	-0.14	2007
8	Suomussalmi	112	0.13	-0.12	2008
9	Suonenjoki	84	0.12	-0.12	2008

Notes: This table lists the municipalities with the largest negative structural breaks in the supply of general, technology and services tracks. Additionally, the table reports the magnitude and year of the break, as well as the number of 16-year-olds and schooling positions per 16-year-olds in the municipality in the break year.

Table A2: Heterogeneity by gender and mother's education: Technology track

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
					PANEL A. GENDER					
Treatment effect	-0.070***	0.053**	-0.014	-0.156***	0.004	-0.014	0.012	-0.022	0.007	0.017
	(0.018)	(0.021)	(0.016)	(0.036)	(0.015)	(0.010)	(0.011)	(0.015)	(0.018)	(0.010)
Treatment*Female	0.021	-0.029	-0.014	0.108**	-0.038**	-0.030**	-0.039***	-0.002	-0.030**	-0.004
	(0.021)	(0.026)	(0.012)	(0.042)	(0.017)	(0.013)	(0.010)	(0.012)	(0.011)	(0.010)
Female	0.170***	-0.133***	0.035***	-0.046**	-0.151***	0.050***	0.043***	0.101***	0.060***	-0.046***
	(0.009)	(0.009)	(0.008)	(0.021)	(0.008)	(0.009)	(0.007)	(0.006)	(0.008)	(0.008)
Observations	62735	62735	62735	52939	62609	62677	62642	62609	61775	61775
Observations in treatment group	10209	10209	10209	8780	10181	10196	10186	10181	10067	10067
Mean in treatment municipalities before break	0.488	0.384	0.869	0.520	0.471	0.704	0.811	0.395	0.542	0.138
					PANEL B. MOTHER'S EDUCATION					
Treatment effect	-0.061***	0.046**	-0.016	-0.097***	-0.018	-0.025**	-0.005	-0.024**	0.002	0.007
	(0.018)	(0.017)	(0.013)	(0.027)	(0.016)	(0.009)	(0.009)	(0.010)	(0.016)	(0.007)
Treatment*Mother with no post-compulsory education	0.006	-0.052***	-0.043**	-0.046*	0.028	-0.036	-0.032*	-0.003	-0.082***	0.068***
	(0.015)	(0.013)	(0.016)	(0.025)	(0.024)	(0.027)	(0.015)	(0.013)	(0.027)	(0.017)
Mother with no post-compulsory education	-0.238***	0.111***	-0.127***	-0.056***	0.061***	-0.163***	-0.166***	-0.213***	0.006	0.092***
	(0.008)	(0.009)	(0.006)	(0.009)	(0.008)	(0.010)	(0.010)	(0.008)	(0.013)	(0.011)
Observations	62735	62735	62735	52939	62609	62677	62642	62609	61775	61775
Observations in treatment group	10209	10209	10209	8780	10181	10196	10186	10181	10067	10067
Mean in treatment municipalities before break	0.488	0.384	0.869	0.520	0.471	0.704	0.811	0.395	0.542	0.138

Notes: This table shows DD estimates of the effect of a drop in the supply of the technology track on educational and labor market outcomes by gender and mother's education. See Table 4 for further table notes. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

Table A3: Heterogeneity by gender and mother's education: Services track

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. GENDER										
Treatment effect	-0.007	-0.018	-0.026**	-0.108***	0.008	-0.020	-0.023	-0.042**	0.015	0.011
	(0.019)	(0.018)	(0.010)	(0.037)	(0.023)	(0.023)	(0.015)	(0.017)	(0.020)	(0.017)
Treatment*Female	0.040**	-0.003	0.032***	0.089**	-0.047***	-0.007	-0.026	0.027	-0.026	-0.011
	(0.016)	(0.021)	(0.011)	(0.038)	(0.012)	(0.021)	(0.019)	(0.019)	(0.025)	(0.018)
Female	0.166***	-0.139***	0.024***	-0.047***	-0.146***	0.039***	0.041***	0.100***	0.048***	-0.052***
	(0.006)	(0.007)	(0.004)	(0.015)	(0.006)	(0.010)	(0.007)	(0.007)	(0.011)	(0.006)
Observations	63347	63347	63347	54397	63181	63272	63227	63181	62342	62342
Observations in treatment group	7979	7979	7979	6943	7940	7963	7950	7940	7866	7866
Mean in treatment municipalities before break	0.481	0.406	0.880	0.588	0.477	0.697	0.820	0.377	0.515	0.162
PANEL B. MOTHER'S EDUCATION										
Treatment effect	0.007	-0.011	-0.008	-0.059**	-0.002	-0.021	-0.037***	-0.035**	0.012	0.001
	(0.017)	(0.016)	(0.007)	(0.027)	(0.021)	(0.017)	(0.009)	(0.016)	(0.016)	(0.010)
Treatment*Mother with no post-compulsory education	0.016	-0.044	-0.025	-0.048	-0.077**	-0.031	0.004	0.024	-0.072***	0.040**
	(0.023)	(0.038)	(0.033)	(0.035)	(0.032)	(0.026)	(0.036)	(0.023)	(0.021)	(0.017)
Mother with no post-compulsory education	-0.252***	0.113***	-0.137***	-0.060***	0.078***	-0.183***	-0.185***	-0.223***	-0.006	0.100***
	(0.011)	(0.012)	(0.012)	(0.010)	(0.006)	(0.013)	(0.013)	(0.008)	(0.012)	(0.007)
Observations	63347	63347	63347	54397	63181	63272	63227	63181	62342	62342
Observations in treatment group	7979	7979	7979	6943	7940	7963	7950	7940	7866	7866
Mean in treatment municipalities before break	0.481	0.406	0.880	0.588	0.477	0.697	0.820	0.377	0.515	0.162

Notes: This table shows DD estimates of the effect of a drop in the supply of the services track on educational and labor market outcomes by gender and mother's education. See Table 4 for further table notes. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

Table A4: OLS results for break status and timing of the drop in supply

	Drop group	Timing of the drop		
	Any field	General	Technology	Services
Share of fathers with post-compulsory degree	3.091*	1.007	-0.796	-0.781
	(1.805)	(0.609)	(1.293)	(1.172)
Share of fathers with HE degree	2.326	-0.454	-1.298	-0.270
	(1.771)	(0.698)	(1.472)	(1.387)
Share of mothers with post-compulsory degree	-3.888**	0.094	-0.492	1.014
	(1.818)	(0.782)	(1.917)	(1.630)
Share of mothers with HE degree	0.320	-0.501	1.588	0.054
	(1.850)	(0.695)	(1.446)	(1.272)
Family income ('000's)	0.013	0.003	0.054**	-0.003
	(0.027)	(0.006)	(0.026)	(0.018)
Share of 16-year-olds	-44.126	36.426*	-6.793	3.038
	(53.924)	(19.901)	(36.321)	(35.659)
Population ('000's)	-0.004**	-0.003	-0.012	-0.026
	(0.002)	(0.003)	(0.019)	(0.057)
Employment rate (ages 25-64)	1.035	1.041	4.108	-0.494
	(1.945)	(0.728)	(2.745)	(1.963)
Income ('000's) (ages 25-64)	-0.060	-0.014	-0.109	0.009
	(0.086)	(0.020)	(0.071)	(0.050)
Rural municipalities	0.638***	-0.224	0.196	0.000
	(0.202)	(0.143)	(0.223)	(.)
Semiurban municipalities	0.410**	-0.190*	0.000	0.043
	(0.155)	(0.110)	(.)	(0.209)
Change in the share of fathers with post-compulsory degree	1.515	-0.165	-0.270	0.802
	(1.153)	(0.369)	(0.947)	(0.683)
Change in the share of fathers with HE degree	-0.316	-0.055	-0.162	-0.316*
	(0.404)	(0.098)	(0.291)	(0.188)
Change in the share of mothers with post-compulsory degree	0.096	-0.371	-0.192	0.022
	(1.268)	(0.568)	(1.242)	(0.995)
Change in the share of mothers with HE degree	-0.331	0.061	-0.207	-0.116
	(0.347)	(0.187)	(0.270)	(0.270)
Change in family income	0.958	-0.102	0.364	0.858
	(0.970)	(0.433)	(0.730)	(0.943)
Change in the share of 16-year-olds	-0.268	-0.313	-0.330	0.226
	(0.644)	(0.240)	(0.402)	(0.317)
Change in population	-3.568	-4.179*	1.070	2.345
	(3.555)	(2.371)	(9.444)	(6.169)
Change in employment rate (ages 25-64)	-0.373	0.469	4.948	0.296
	(4.754)	(1.647)	(3.698)	(3.129)
Change in income (ages 25-64)	-2.591	1.588	5.604	1.835
	(5.009)	(1.581)	(4.341)	(3.941)
N	67	154	49	63
R^2	0.533	0.118	0.430	0.177

Notes: This table reports results from OLS regressions that explore the association between municipality-level characteristics and the treatment status of municipalities (column 1), or between municipal characteristics and the timing of supply reductions (columns 2-4). The regression in the first column includes municipalities in the drop and flat groups. The dependent variable receives the value one if the municipality belongs to the drop group for at least one of the three education fields. The independent variables are measured from the period before the estimated maximum break, i.e. the levels are defined from the year 2001, and the changes from the year 1999 to 2001. The estimation samples in the latter three columns include only the drop municipalities for the given education field for the years 2003-2009. Here the dependent variable gets the value one for the first post-treatment year, and the independent variables are defined from the year before, or for the change during the two prior years.

Table A5: Robustness to alternative specifications: General track

	1	2	3	4	5
PANEL A. OUTCOMES AT AGE 16					
Enrolled in GEN at 16	-0.028***	-0.027***	-0.025***	-0.016**	-0.008
	(0.009)	(0.009)	(0.009)	(0.006)	(0.009)
Observations	173630	173630	173630	173630	173630
Enrolled in VOC at 16	0.020**	0.019**	0.016**	0.013*	0.009
	(0.008)	(0.008)	(0.007)	(0.007)	(0.011)
Observations	173630	173630	173630	173630	173630
Enrolled in any at 16	-0.010	-0.010	-0.011	-0.004	0.004
	(0.007)	(0.006)	(0.006)	(0.006)	(0.008)
Observations	173630	173630	173630	173630	173630
Enrolled in home municipality at 16	-0.021	-0.021	-0.021	-0.013	-0.001
	(0.014)	(0.014)	(0.015)	(0.013)	(0.012)
Observations	147453	147453	147453	147453	147453
PANEL B. OUTCOMES AT AGES 19-21					
Lives in home municipality at 21	-0.011	-0.012	-0.013	-0.015*	0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Observations	173326	173326	173326	173326	173326
Secondary degree by age 19	-0.010	-0.010	-0.010	0.000	0.010
	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)
Observations	173502	173502	173502	173502	173502
Secondary degree by age 20	-0.000	-0.000	-0.000	0.004	0.008
	(0.008)	(0.008)	(0.008)	(0.007)	(0.010)
Observations	173412	173412	173412	173412	173412
HE enrollment by age 21	-0.003	-0.002	-0.000	0.003	-0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)
Observations	173326	173326	173326	173326	173326
Employed at 21	0.019**	0.019**	0.017**	0.014*	0.008
	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)
Observations	170492	170492	170492	170492	170492
NEET at 21	0.001	0.001	0.001	0.001	0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)
Observations	170492	170492	170492	170492	170492
Individual characteristics	No	Yes	Yes	Yes	No
Parental characteristics	No	No	Yes	Yes	No
Municipal characteristics	No	No	No	Yes	No
Municipal trends	No	No	No	No	Yes

Notes: This table shows DD estimates of the effect of a drop in general education supply on educational and labor market outcomes. The treatment effect variable is an interaction of a drop group dummy and an indicator of whether the year is after the estimated year of the structural break. The estimations use data from municipalities in the drop (estimated structural break between -0.1 and -1) and flat (estimated structural break between -0.1 and 0.1) groups. We focus on municipalities in which the estimated maximum break occurs between the years 2002 and 2008 (drop in supply occurs between the years 2003-2009). All specifications include municipality and year fixed effects. Individual characteristics include indicators for the gender and native language (Finnish, Swedish or other) of the 16-year-olds. Parental characteristics include parents' educational level (dummies for compulsory, post-compulsory, higher education degree and whether parents have matriculated), and dummy for whether this information is found in the data. Municipal characteristics include the share of 16-year-olds, population, employment rate and mean income in municipalities. The information on whether the student has enrolled in their home municipality at 16 is missing for the year 1997, which corresponds to t=-5 for some of the municipalities, but the estimates are robust to specifications excluding t=-5. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1 ** p<0.05 ***p<0.01

Table A6: Robustness to alternative specifications: Technology track

	1	2	3	4	5
PANEL A. OUTCOMES AT AGE 16					
Enrolled in GEN at 16	-0.059***	-0.059***	-0.053***	-0.057***	-0.035
	(0.018)	(0.018)	(0.017)	(0.017)	(0.020)
Observations	62735	62735	62735	62735	62735
Enrolled in VOC at 16	0.039**	0.039**	0.034*	0.035*	0.033
	(0.017)	(0.017)	(0.017)	(0.019)	(0.019)
Observations	62735	62735	62735	62735	62735
Enrolled in any at 16	-0.020	-0.020	-0.019	-0.020	-0.003
	(0.014)	(0.014)	(0.013)	(0.013)	(0.017)
Observations	62735	62735	62735	62735	62735
Enrolled in home municipality at 16	-0.102***	-0.102***	-0.100***	-0.099***	-0.053*
	(0.026)	(0.026)	(0.027)	(0.027)	(0.027)
Observations	52939	52939	52939	52939	52939
PANEL B. OUTCOMES AT AGES 19-21					
Lives in home municipality at 21	-0.015	-0.014	-0.018	-0.009	-0.014
	(0.015)	(0.014)	(0.014)	(0.017)	(0.015)
Observations	62609	62609	62609	62609	62609
Secondary degree by age 19	-0.028***	-0.027***	-0.026**	-0.018**	-0.020
	(0.008)	(0.009)	(0.010)	(0.009)	(0.011)
Observations	62677	62677	62677	62677	62677
Secondary degree by age 20	-0.008	-0.007	-0.005	0.000	-0.013
	(0.010)	(0.010)	(0.011)	(0.011)	(0.019)
Observations	62642	62642	62642	62642	62642
HE enrollment by age 21	-0.023**	-0.022**	-0.017	-0.016*	-0.025*
	(0.010)	(0.010)	(0.010)	(0.009)	(0.013)
Observations	62609	62609	62609	62609	62609
Employed at 21	-0.008	-0.008	-0.010	-0.022	-0.002
	(0.014)	(0.014)	(0.014)	(0.013)	(0.026)
Observations	61775	61775	61775	61775	61775
NEET at 21	0.015**	0.014**	0.013*	0.017**	0.006
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Observations	61775	61775	61775	61775	61775
Individual characteristics	No	Yes	Yes	Yes	No
Parental characteristics	No	No	Yes	Yes	No
Municipal characteristics	No	No	No	Yes	No
Municipal trends	No	No	No	No	Yes

Notes: This table shows DD estimates of the effect of a drop in technology education supply on educational and labor market outcomes. See Table A5 for further table notes. * p<0.1 ** p<0.05 ***p<0.01

Table A7: Robustness to alternative specifications: Services track

	1	2	3	4	5
PANEL A. OUTCOMES AT AGE 16					
Enrolled in GEN at 16	0.011	0.013	0.022	0.025	-0.026
	(0.016)	(0.016)	(0.015)	(0.017)	(0.023)
Observations	63347	63347	63347	63347	63347
Enrolled in VOC at 16	-0.018	-0.019	-0.026*	-0.031**	0.025
	(0.014)	(0.014)	(0.014)	(0.015)	(0.016)
Observations	63347	63347	63347	63347	63347
Enrolled in any at 16	-0.010	-0.009	-0.007	-0.006	-0.005
	(0.009)	(0.009)	(0.008)	(0.008)	(0.011)
Observations	63347	63347	63347	63347	63347
Enrolled in home municipality at 16	-0.064**	-0.064**	-0.063**	-0.067**	-0.071*
	(0.028)	(0.028)	(0.028)	(0.029)	(0.040)
Observations	54397	54397	54397	54397	54397
PANEL B. OUTCOMES AT AGES 19-21					
Lives in home municipality at 21	-0.013	-0.014	-0.018	-0.005	0.003
	(0.020)	(0.020)	(0.020)	(0.020)	(0.034)
Observations	63181	63181	63181	63181	63181
Secondary degree by age 19	-0.024	-0.023	-0.020	-0.011	-0.007
	(0.018)	(0.017)	(0.016)	(0.016)	(0.021)
Observations	63272	63272	63272	63272	63272
Secondary degree by age 20	-0.035***	-0.035***	-0.032***	-0.024**	-0.011
	(0.011)	(0.011)	(0.010)	(0.010)	(0.020)
Observations	63227	63227	63227	63227	63227
HE enrollment by age 21	-0.030*	-0.029*	-0.022	-0.014	-0.037*
	(0.016)	(0.016)	(0.013)	(0.014)	(0.021)
Observations	63181	63181	63181	63181	63181
Employed at 21	0.003	0.003	0.000	-0.007	0.014
	(0.016)	(0.016)	(0.015)	(0.015)	(0.032)
Observations	62342	62342	62342	62342	62342
NEET at 21	0.006	0.006	0.004	0.004	0.017
	(0.010)	(0.010)	(0.009)	(0.011)	(0.023)
Observations	62342	62342	62342	62342	62342
Individual characteristics	No	Yes	Yes	Yes	No
Parental characteristics	No	No	Yes	Yes	No
Municipal characteristics	No	No	No	Yes	No
Municipal trends	No	No	No	No	Yes

Notes: This table shows DD estimates of the effect of a drop in services education supply on educational and labor market outcomes.See Table A5 for further table notes. * p<0.1 ** p<0.05 ***p<0.01

Table A8: Robustness to excluding urban municipalities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. DROP IN THE SUPPLY OF GENERAL TRACK										
Treatment effect	-0.021	0.030**	0.011	-0.014	-0.007	-0.002	0.002	-0.010	0.017	0.009
	(0.014)	(0.012)	(0.010)	(0.014)	(0.012)	(0.013)	(0.015)	(0.012)	(0.011)	(0.011)
Observations	32215	32215	32215	27335	32156	32188	32169	32156	31679	31679
Observations in treatment group	25577	25577	25577	21640	25526	25550	25533	25526	25149	25149
Mean in treatment municipalities before break	0.499	0.365	0.862	0.614	0.516	0.686	0.802	0.421	0.497	0.138
PANEL B. DROP IN THE SUPPLY OF TECHNOLOGY TRACK										
Treatment effect	-0.059*	0.032	-0.026	-0.077**	-0.004	-0.042***	-0.033**	-0.027**	-0.015	0.026***
	(0.027)	(0.022)	(0.016)	(0.029)	(0.026)	(0.013)	(0.012)	(0.010)	(0.016)	(0.007)
Observations	17538	17538	17538	15222	17497	17521	17508	17497	17262	17262
Observations in treatment group	10209	10209	10209	8780	10181	10196	10186	10181	10067	10067
Mean in treatment municipalities before break	0.488	0.384	0.869	0.520	0.471	0.704	0.811	0.395	0.542	0.138
PANEL C. DROP IN THE SUPPLY OF SERVICES TRACK										
Treatment effect	0.012	-0.020	-0.007	-0.047	-0.001	-0.007	-0.025	-0.016	-0.010	0.001
	(0.018)	(0.012)	(0.013)	(0.040)	(0.026)	(0.020)	(0.016)	(0.016)	(0.019)	(0.011)
Observations	20789	20789	20789	17962	20715	20755	20735	20715	20510	20510
Observations in treatment group	7979	7979	7979	6943	7940	7963	7950	7940	7866	7866
Mean in treatment municipalities before break	0.481	0.406	0.880	0.588	0.477	0.697	0.820	0.377	0.515	0.162

Notes: The specification is otherwise the same as in Table 4, but we exclude urban municipalities from the regression. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

Table A9: Robustness to definition of municipality of residence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. DROP IN THE SUPPLY OF GENERAL TRACK										
Treatment effect	-0.022***	0.020***	-0.004	-0.023*	-0.011	-0.005	0.000	0.001	0.015*	-0.000
	(0.008)	(0.007)	(0.006)	(0.013)	(0.007)	(0.008)	(0.006)	(0.005)	(0.008)	(0.006)
Observations	166069	166069	166069	140997	165786	165951	165867	165786	163035	163035
Observations in treatment group	48423	48423	48423	41487	48341	48385	48360	48341	47595	47595
Mean in treatment municipalities before break	0.527	0.357	0.867	0.619	0.498	0.654	0.790	0.413	0.517	0.138
PANEL B. DROP IN THE SUPPLY OF TECHNOLOGY TRACK										
Treatment effect	-0.040***	0.026*	-0.015	-0.081***	-0.005	-0.022**	0.003	-0.014*	-0.010	0.005
	(0.013)	(0.014)	(0.011)	(0.025)	(0.011)	(0.009)	(0.010)	(0.007)	(0.010)	(0.004)
Observations	57675	57675	57675	48596	57554	57625	57590	57554	56729	56729
Observations in treatment group	9485	9485	9485	8150	9459	9471	9462	9459	9331	9331
Mean in treatment municipalities before break	0.475	0.398	0.868	0.422	0.402	0.693	0.801	0.381	0.548	0.141
PANEL C. DROP IN THE SUPPLY OF SERVICES TRACK										
Treatment effect	-0.005	-0.001	-0.006	-0.070***	-0.019	-0.019	-0.024**	-0.021	0.018	0.000
	(0.016)	(0.015)	(0.009)	(0.025)	(0.015)	(0.016)	(0.009)	(0.015)	(0.012)	(0.011)
Observations	60943	60943	60943	51893	60788	60876	60832	60788	59963	59963
Observations in treatment group	7790	7790	7790	6736	7753	7774	7763	7753	7674	7674
Mean in treatment municipalities before break	0.475	0.407	0.872	0.470	0.395	0.689	0.809	0.372	0.507	0.162

Notes: The specification is otherwise the same as in Table 4, but instead of defining the home municipality (and the relevant supply) using the municipality of residence at the age of 15, we use the municipality at birth. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

Table A10: Robustness to definition of drop and flat break groups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. DROP IN THE SUPPLY OF GENERAL TRACK										
Treatment effect	-0.030**	0.018*	-0.007	-0.063**	-0.024***	-0.010	0.012	0.002	0.009	0.003
	(0.012)	(0.010)	(0.009)	(0.026)	(0.009)	(0.015)	(0.013)	(0.009)	(0.011)	(0.008)
Observations	180878	180878	180878	153846	180562	180747	180655	180562	177644	177644
Observations in treatment group	18589	18589	18589	15521	18553	18569	18559	18553	18179	18179
Mean in treatment municipalities before break	0.523	0.333	0.854	0.576	0.541	0.673	0.787	0.433	0.516	0.129
PANEL B. DROP IN THE SUPPLY OF TECHNOLOGY TRACK										
Treatment effect	-0.016	0.021	0.000	-0.164***	-0.008	-0.028***	-0.027***	-0.012	-0.011	0.017***
	(0.032)	(0.017)	(0.016)	(0.039)	(0.029)	(0.004)	(0.004)	(0.017)	(0.034)	(0.003)
Observations	161037	161037	161037	135450	160705	160887	160795	160705	158441	158441
Observations in treatment group	2339	2339	2339	2005	2329	2335	2331	2329	2315	2315
Mean in treatment municipalities before break	0.433	0.435	0.861	0.544	0.419	0.714	0.828	0.400	0.521	0.144
PANEL C. DROP IN THE SUPPLY OF SERVICES TRACK										
Treatment effect	0.033	-0.038**	-0.016	-0.068	0.007	0.012	-0.017	-0.018	0.024	-0.016
	(0.021)	(0.016)	(0.022)	(0.048)	(0.034)	(0.056)	(0.031)	(0.048)	(0.017)	(0.010)
Observations	65880	65880	65880	56688	65709	65803	65755	65709	64838	64838
Observations in treatment group	1964	1964	1964	1712	1955	1959	1955	1955	1932	1932
Mean in treatment municipalities before break	0.489	0.400	0.885	0.590	0.421	0.699	0.828	0.369	0.530	0.150

Notes: The specification is otherwise the same as in Table 4, but we use a cutoff (-)0.2 to define the break groups, instead of (-)0.1. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

Table A11: Robustness to definition of drop in supply

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16	Lives in home municipality at 21	Secondary degree by age 19	Secondary degree by age 20	HE enrollment by age 21	Employed at 21	NEET at 21
PANEL A. DROP IN THE SUPPLY OF GENERAL TRACK										
Treatment effect	-0.057***	0.038**	-0.021***	-0.185***	0.023	-0.011	-0.009	-0.013	0.033*	-0.011
	(0.019)	(0.018)	(0.004)	(0.059)	(0.015)	(0.019)	(0.010)	(0.010)	(0.018)	(0.007)
Observations	690521	690521	690521	581714	689265	690012	689651	689265	631412	631412
Observations in treatment group	3139	3139	3139	2720	3130	3133	3131	3130	3097	3097
Mean in treatment municipalities before break	0.513	0.376	0.886	0.389	0.407	0.684	0.807	0.392	0.475	0.161
PANEL B. DROP IN THE SUPPLY OF TECHNOLOGY TRACK										
Treatment effect	-0.026	0.027*	0.001	-0.076**	-0.034**	-0.023**	-0.005	-0.020**	-0.000	0.007
	(0.023)	(0.015)	(0.013)	(0.031)	(0.015)	(0.010)	(0.010)	(0.009)	(0.014)	(0.008)
Observations	453503	453503	453503	374838	452695	453184	452954	452695	418004	418004
Observations in treatment group	12798	12798	12798	10981	12762	12782	12771	12762	12506	12506
Mean in treatment municipalities before break	0.483	0.382	0.862	0.514	0.496	0.700	0.810	0.394	0.537	0.144
PANEL C. DROP IN THE SUPPLY OF SERVICES TRACK										
Treatment effect	-0.018	0.013	-0.008	-0.081***	0.001	-0.005	0.002	-0.008	0.019*	-0.007
	(0.012)	(0.008)	(0.010)	(0.016)	(0.012)	(0.013)	(0.012)	(0.009)	(0.011)	(0.005)
Observations	502281	502281	502281	417469	501384	501929	501662	501384	463036	463036
Observations in treatment group	23141	23141	23141	20070	23064	23107	23083	23064	22545	22545
Mean in treatment municipalities before break	0.523	0.358	0.875	0.576	0.492	0.668	0.793	0.388	0.516	0.151

Notes: The specification is otherwise the same as in Table 4, but instead of using the structural breaks method to define the treatment and control groups, we use the percentual change in the supply. Here treated municipalities include those with a drop of 50 percent or more in the supply of the given education in the years 2003-2009. The control municipalities include those with less than 20 percent of yearly fluctuation in the educational supply. Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

Table A12: Robustness to break years

	(1)	(2)	(3)	(4)
	Enrolled in GEN at 16	Enrolled in VOC at 16	Enrolled in any at 16	Enrolled in home municipality at 16
PANEL A. DROP IN THE SUPPLY OF GENERAL TRACK				
Treatment effect	-0.034***	0.030**	-0.006	-0.022
	(0.006)	(0.011)	(0.011)	(0.022)
Observations	129975	129975	129975	109420
Observations in treatment group	34404	34404	34404	29420
Mean in treatment municipalities before break	0.465	0.394	0.856	0.651
PANEL B. DROP IN THE SUPPLY OF TECHNOLOGY TRACK				
Treatment effect	-0.005	0.024	0.016	-0.070**
	(0.016)	(0.020)	(0.014)	(0.026)
Observations	94776	94776	94776	80709
Observations in treatment group	8796	8796	8796	7450
Mean in treatment municipalities before break	0.455	0.389	0.838	0.555
PANEL C. DROP IN THE SUPPLY OF SERVICES TRACK				
Treatment effect	-0.019**	-0.003	-0.013	-0.034
	(0.009)	(0.011)	(0.009)	(0.022)
Observations	260198	260198	260198	216899
Observations in treatment group	23585	23585	23585	20575
Mean in treatment municipalities before break	0.480	0.412	0.879	0.783

Notes: The specification is otherwise the same as in Table 4, but instead of using the break years 2002-2008 we use the break years 2007-2013 (the breaks are estimated using the years 2002-2017, and we include in the sample the municipalities with the maximum break in the years 2007-2013). Standard errors (in parentheses) are clustered at the municipality level. * p<0.1, ** p<0.05 and *** p <0.01.

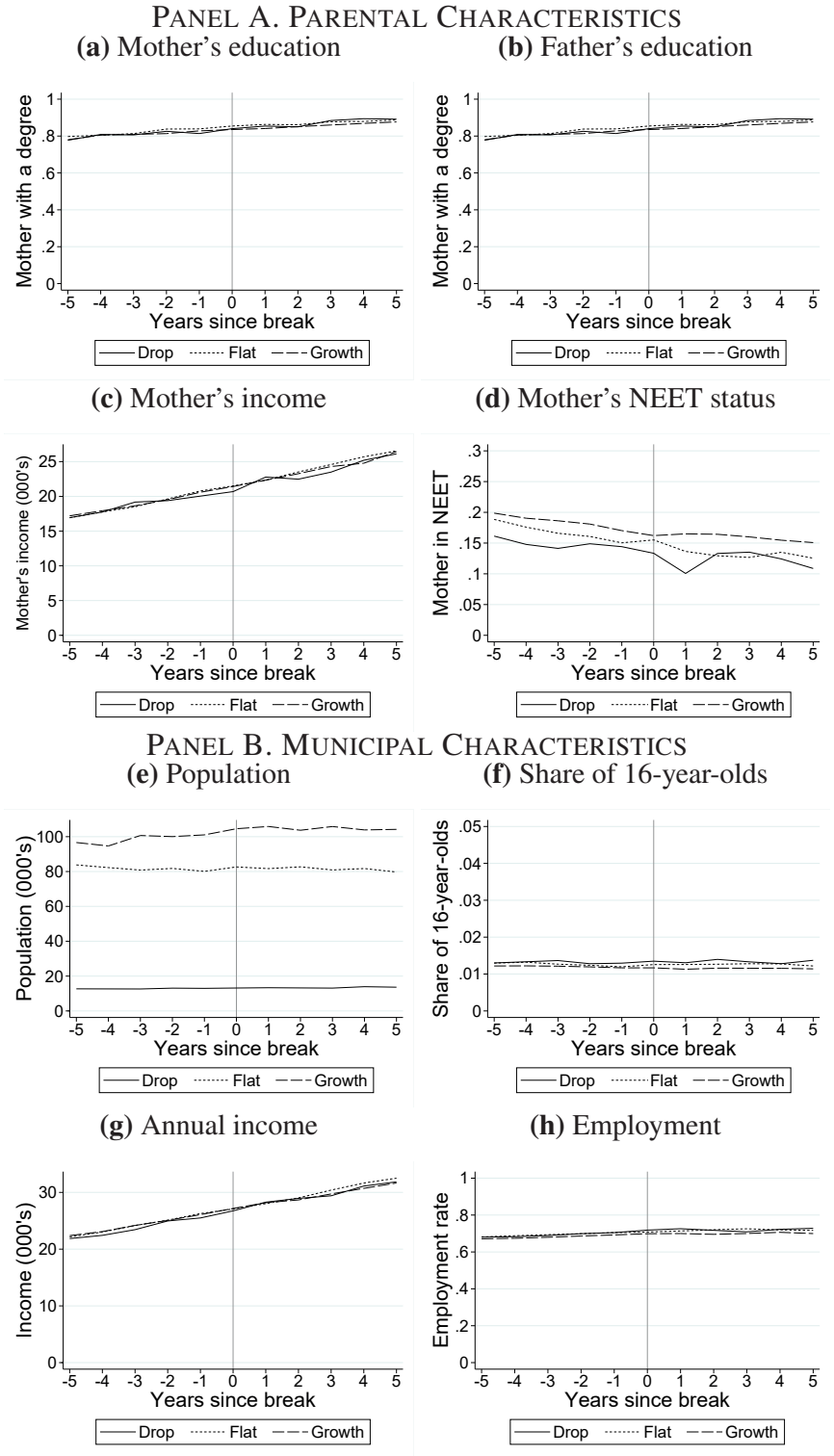

Figure A1: Covariates in the break groups before and after the break: technology track

Notes: This figure depicts the mean parental characteristics for the cohorts, and the mean municipal characteristics for the municipalities in the three break groups (drop, growth and flat) each year from three years before to five years after the break.

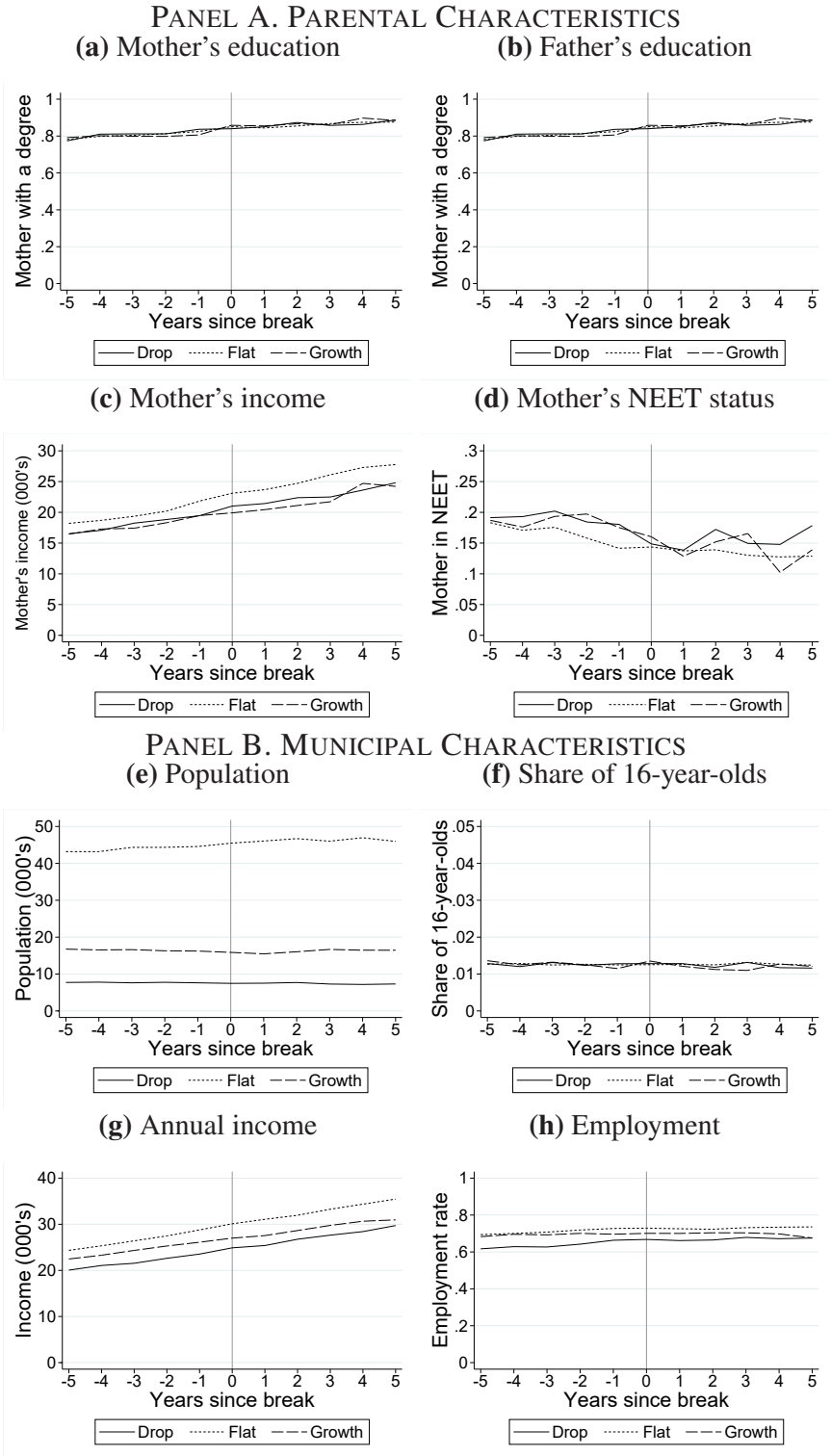

Figure A2: Covariates in the break groups before and after the break: services track

Notes: This figure depicts the mean parental characteristics for the cohorts, and the mean municipal characteristics for the municipalities in the three break groups (drop, growth and flat) each year from three years before to five years after the break.

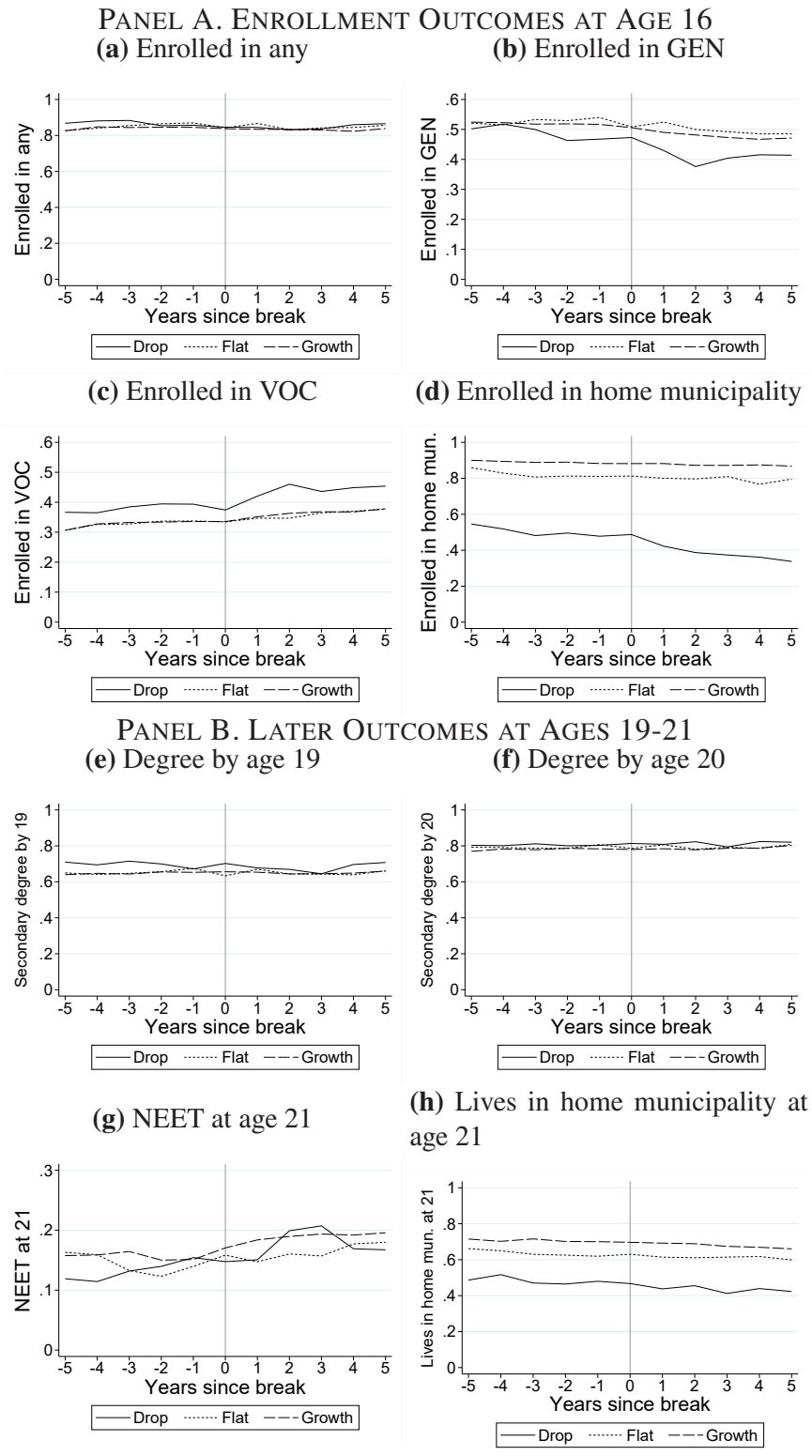

Figure A3: Outcomes in the break groups before and after the break: technology track

Notes: This figure depicts the means for the outcome variables for the municipalities in the three break groups (drop, growth and flat) each year from three years before to five years after the break.

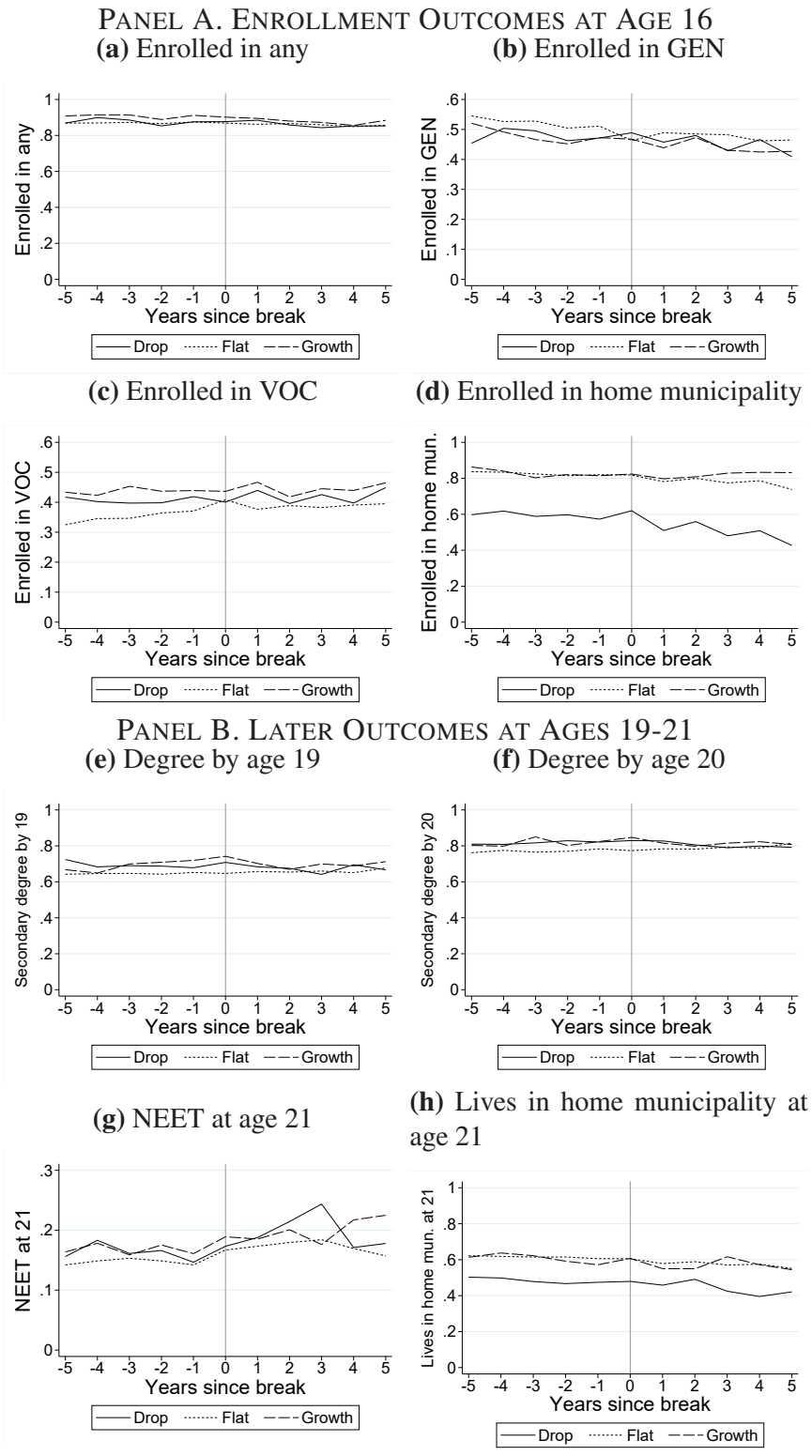

Figure A4: Outcomes in the break groups before and after the break: services track

Notes: This figure depicts the means for the outcome variables for the municipalities in the three break groups (drop, growth and flat) each year from three years before to five years after the break.

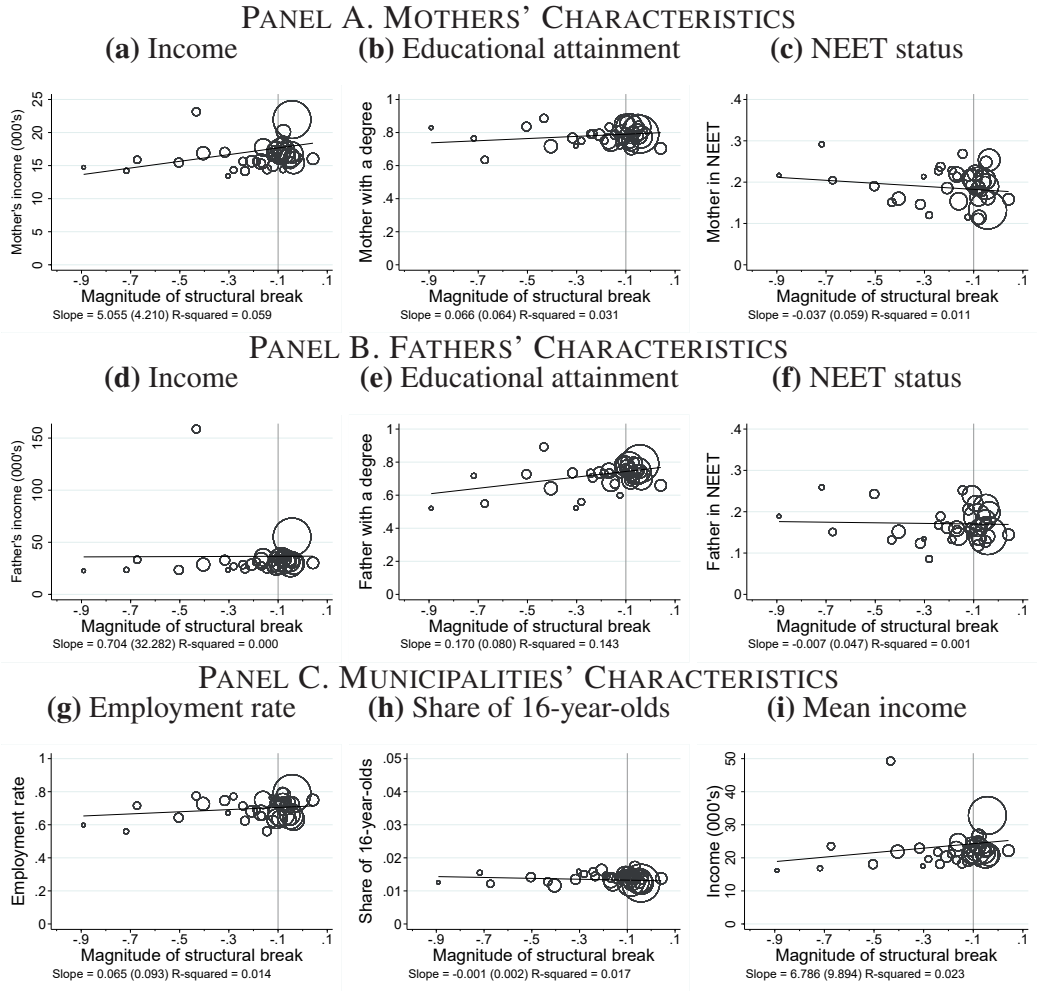

Figure A5: Covariates and the magnitude of the structural break: General track

Notes: This figure shows the relationship between the magnitude of the structural break and the mean levels of parental and municipal characteristics in the pre-treatment years 1999-2001 for the municipalities in the drop and flat groups. The fitted lines in the graphs are a weighted regression using the 16-year-old population as weights.

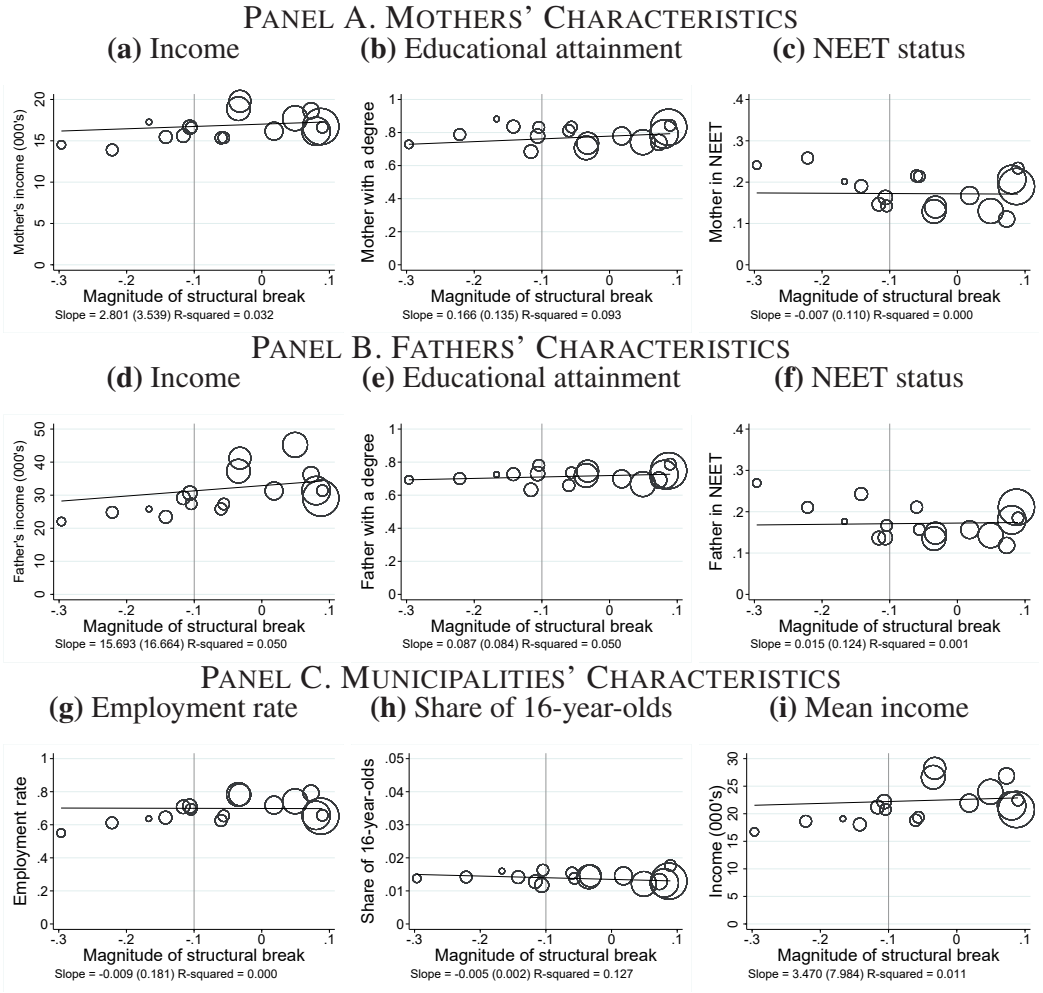

Figure A6: Covariates and the magnitude of the structural break: Technology track

Notes: This figure shows the relationship between the magnitude of the structural break and the mean levels in parental and municipal characteristics in the pre-treatment years 1999-2001 for the municipalities in the drop and flat groups. The fitted lines in the graphs are a weighted regression using the 16-year-old population as weights.

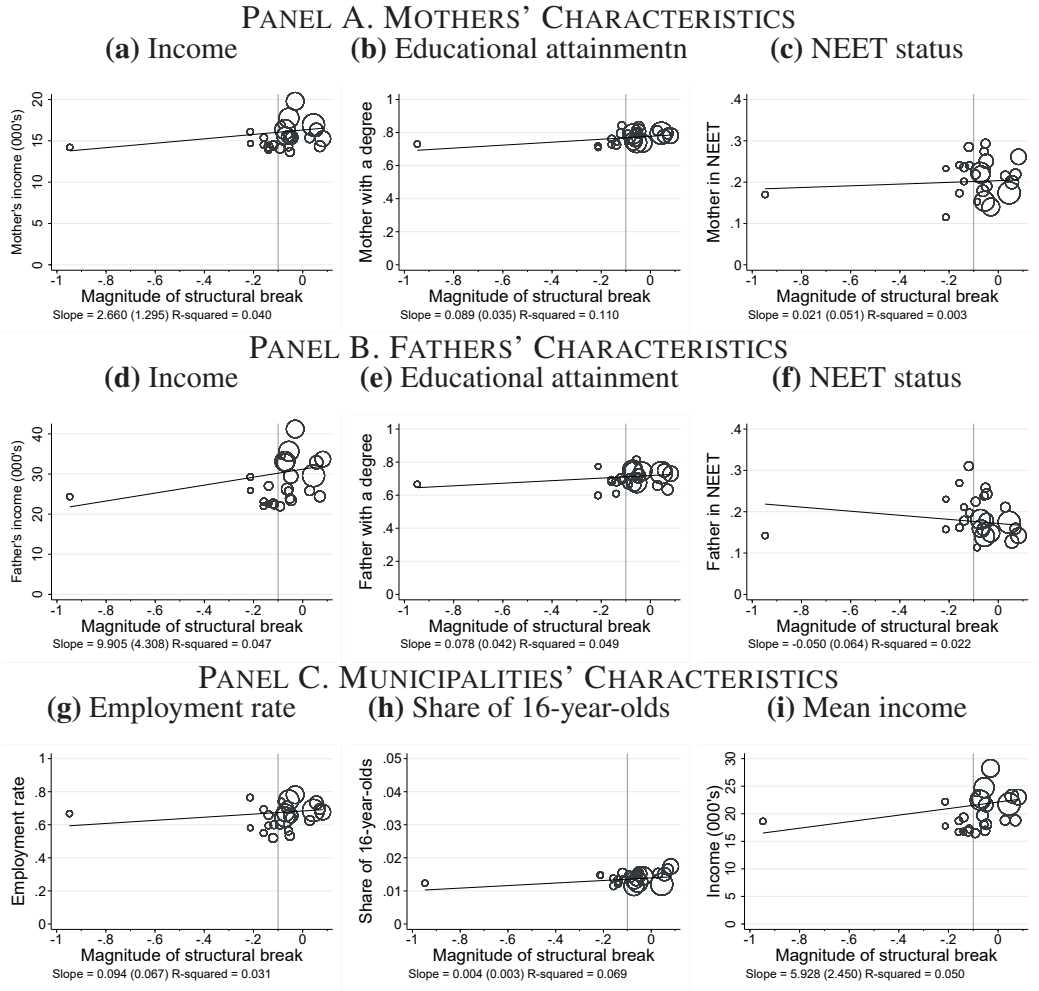

Figure A7: Covariates and the magnitude of the structural break: Services track

Notes: This figure shows the relationship between the magnitude of the structural break and the mean levels in parental and municipal characteristics in the years before the break 1999-2001 for the municipalities in the drop and flat groups. The fitted lines in the graphs are a weighted regression using the 16-year-old population as weights.

Elinkeinoelämän tutkimuslaitos

ETLA Economic Research

ISSN-L 2323-2420
ISSN 2323-2420 (print)
ISSN 2323-2439 (pdf)

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