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Philipp Markus

Effects of Access to Universities on Education and Migration Decisions

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Imprint

Ruhr Economic Papers

Published by

RWI – Leibniz-Institut für Wirtschaftsforschung
Hohenzollernstr. 1-3, 45128 Essen, Germany

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Ruhr Economic Papers #996

Responsible Editor: Volker Clausen

ISSN 1864-4872 (online) – ISBN 978-3-96973-162-8

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Bibliografische Informationen der Deutschen Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at **http://dnb.dnb.de**

RWI is funded by the Federal Government and the federal state of North Rhine-Westphalia.

http://dx.doi.org/10.4419/96973162
ISSN 1864-4872 (online)
ISBN 978-3-96973-162-8

Philipp Markus[1]

Effects of Access to Universities on Education and Migration Decisions

Abstract

The paper examines the effect of access to universities on education and migration decisions of young adults. So far, studies on the causal effect of education on mobility have mainly focused on labor market mobility of high-skilled workers after finishing their educational career, due to the lack of suitable data or the problem of endogeneity between education and mobility. I exploit the exogenous variation induced by a large-scale tertiary education expansion reform beginning in the 1970s in Sweden to investigate the impact of the change in access to universities on college participation rates and migration patterns of high school graduates. Using individual administrative data, I find that if a new higher education institution opens in a municipality, the high school graduates of that location are 6.6% more likely to attend college. At the same time, their propensity to move out of the municipality in the four years after finishing secondary education decreases by 10.1%. In contrast, high school graduates in the catchment area of the new institution show no change in college participation rates and, if anything, an increased propensity to leave the municipality of high school graduation. My results indicate that the effects on education and migration are mainly local and non-linear in geographical distance.

JEL-Codes: I23, I28, J11, R23, R58

Keywords: Education economics; migration economics; university expansion reform; mobility of high school graduates

January 2023

1 Philipp Markus, RGS Econ and UDE. *– I thank Tobias Seidel, Martin Karlsson, Therese Nilsson, Arnaud Chevalier, Nadine Riedel, Martin Fischer, Matthew Collins, Maren Kaliske, Malte Borghorst, members of the Research Training Group (RTG) Regional Disparities & Economic Policy, the Ruhr Graduate School in Economics (RGS Econ), the Mercator School of Management of University of Duisburg-Essen and the Department of Economics of Lund University as well as participants of various seminars for fruitful comments and competent research assistance. I thank the Centre for Economic Demography (CED) in Lund for generously providing the data. Financial support from the German Research Foundation (DFG) via the RTG Regional Disparities & Economic Policy and the RGS Econ is gratefully acknowledged. The usual caveat applies. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. There are no interests to declare.* *– All correspondence to: Philipp Markus, University of Duisburg-Essen, Lotharstr. 65, 47057 Duisburg, Germany, e-mail: philipp.markus@uni-due.de*

1 Introduction

Internal migration is a decisive factor in softening or fostering regional disparities along many dimensions. The flow of workers is important for local labor markets, and the demographic composition of a region's population can shape the provision of amenities and local public goods. Politicians, locally but also at the national level, consider place-based policies as a legitimate way to make certain regions more appealing, either to attract new inhabitants or to make existing residents more likely to stay. One of these place-based policies is to open a new educational institution, which is usually intended to increase local human capital and make a region more attractive, specifically for young adults. However, evidence of the effectiveness of such local policy interventions is very mixed and often depends heavily on internal migration behavior (see Neumark and Simpson (2015) for an overview).

In this paper, I estimate the effects of opening new higher education institutions (HEI) by analyzing a Swedish tertiary education expansion reform beginning in the 1970s. I answer the following questions: Does opening a new HEI makes the local youth more likely to receive college education? And how do migration patterns in that region but also its catchment area change?

Answering these questions is challenging since location and education decisions are known to interact. People move to live closer to an institution providing access to education while the level of education impacts mobility patterns over the life cycle. Especially workers with a college degree tend to be more mobile both at the extensive as well as the intensive margin (see among others DaVanzo, 1978; Corcoran and Faggian, 2017; Plane, 1993). There are some studies investigating the reverse relationship by documenting a negative correlation between the distance to the closest higher education institution and college enrollment (see among others Groen, 2004; Frenette, 2006; Cooke and Boyle, 2011; Alm and Winters, 2009). However, the location of HEI and the place of residence are both likely to be non-random. Some universities were founded hundreds of years ago and have shaped the local demographic and economic development until today. I exploit an arguably exogenous variation in access to higher education by focusing on the openings of new universities and university colleges in Sweden between 1968 and 2012. By using a two-way fixed effects approach I control for time-consistent differences between municipalities as well as national time trends. Since the new institutions were founded in different years I use a dynamic Difference-in-Difference (DiD) estimation method, usually referred to as event study (see Roth et al. (2022) and Chaisemartin and D 'Haultfoeuille (2022) for a review of the latest development). It compares individuals

from "treated regions" (i.e. municipalities where a university or university college was newly opened within a certain range) with individuals from "control regions" (i.e. municipalities that never had a higher education institution close by), relative to the difference between those two groups that existed already before the new institution started to exist.

I have three main findings. First, opening new higher education institutions increases participation in tertiary education by about 6.6% in the same municipality, but there are no spatial spillovers to neighboring regions. Second, young adults are, on average, 10.1% less likely to move out of their home municipality when a new HEI opens in that region. Both effects are significant on all conventional levels. Third, young adults from the catchment area have a slightly but non-significantly increased propensity to move out of their home municipality, where the new nearby HEI is the main destination of migration. Hence, the regional demographic effects of a higher education expansion are very heterogeneous. While municipalities with a new university experience a growing share of young adults due to increased levels of in-migration and lower levels of out-migration, surrounding municipalities see the other side of the same coin: more young adults move away than would without the new HEI close by. I do not find evidence for effects on mobility at later stages of life. There is no significant impact on location choices or total labor market mobility. This has important implications for policymakers that intend to use the founding of a new education institution as a placed-based policy to foster local education outcomes or more general regional development.

There already are some studies that evaluate similar education expansion reforms.[1] Most recently, Berlingieri et al. (2022) find that opening colleges and universities in Germany led to an increasing supply of high-skilled labor without any drops in wages, similar to Carneiro et al. (2022) in Norway. Liu (2015) finds evidence for positive long-run effects on income via general agglomeration economies caused by an increase in population. Besides labor market effects, local innovative activities have been shown to be positively related to higher education expansion reforms in Sweden (Andersson et al., 2009) and Switzerland (Lehnert et al., 2020). Suhonen and Karhunen (2019) find evidence that a Finnish higher education expansion reform increases spillover effects from parental to children's education, while Kamhöfer and Westphal (2017) document negative effects on fertility in Germany. Of course, the direct effect on education outcomes has been studied as well. Frenette (2009) finds comparable positive effects on university attendance among the local youth. Others, like Gibbons and Vignoles (2012), were able to reproduce this result

[1] See Kyvik (2009) for an overview of higher education expansion reforms.

only for low-income households. I contribute to this strand of the literature in three ways. First, I confirm that the distance to the closest HEI matters for participation in university education, even in a context where the monetary costs of moving out are low. Second, I provide evidence that newly opened universities affect not only the educational and economic but also the demographic characteristics of a region via changes in migration patterns. Third, my results emphasize the importance of distance to the new institution and potential negative spillovers to neighboring regions that so far have been overlooked.

This is also relevant for the large literature estimating marginal effects of education, most prominently on wages (e.g. Card, 2001) or non-pecuniary benefits (e.g. Oreopoulos and Salvanes, 2011). There is a tradition of using the proximity to educational institutions as an instrument (see for example Carneiro et al., 2011), based on the assumption that distance to the closest school or college is (negatively) correlated with educational outcomes. My findings of notable effect heterogeneity by distance suggest that the instrument has to be used with a lot of caution for some outcomes.

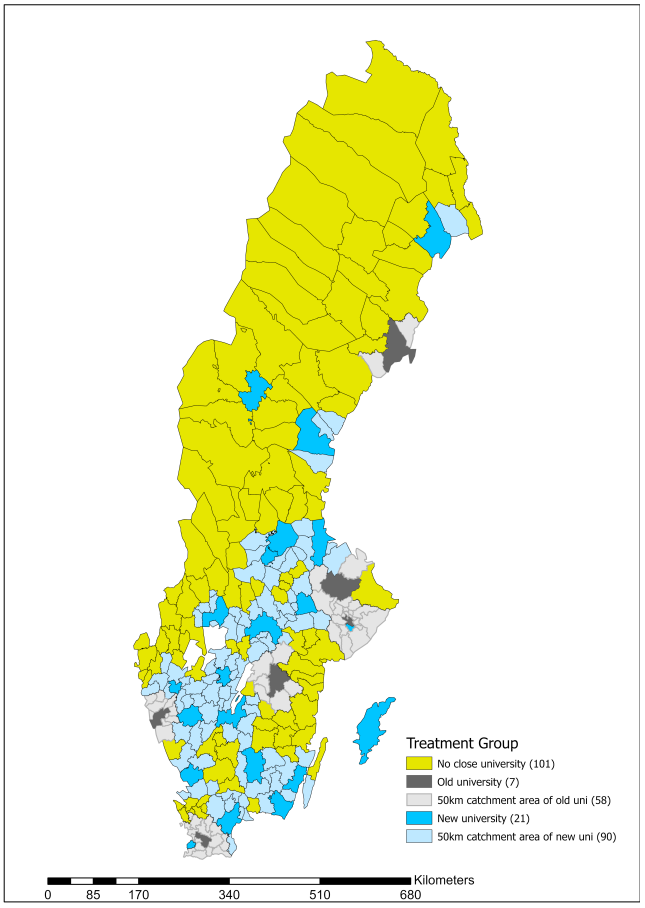
I also contribute to the large migration literature. Although surveys show that education is one of the main reasons for migration among young adults (Lundholm et al., 2004), most of the papers focus on the role of labor markets as determinants of (internal) migration (see for example Molloy et al., 2011). My results confirm that access to (higher) education affects the migration decisions of young adults as well, especially before entering the labor market.

The next section summarizes the institutional background of the Swedish tertiary education landscape and the expansion reform beginning in the 70s. Section 3 describes the data. After discussing the empirical method, I show my main empirical results in section 5. The final section concludes.

2 Institutional Background

In 1970, 19 higher education institutions (HEIs) operated in seven different municipalities in Sweden. The locations are depicted in dark gray in Figure 1. Only six

Figure 1: Access to tertiary education in Sweden



Sweden's municipalities with boundaries of 1977 grouped by treatment status. The number of municipalities of each group is in parentheses.

of the 19 institutions were universities providing general tertiary education at that time.[2] The other HEIs were more specialized and affiliated with a university. Therefore, they were located in the same municipalities as the general universities. The only exception is the Karolinska Institute in Solna, which is a part of the greater area of Stockholm. In Sweden, tertiary education is provided by universities (*Universitet*) and university colleges (*Högskolan*). In contrast to universities, university colleges do not provide doctoral education. As this difference is of no relevance to the scope of my paper, the terms university, college, and HEI are used interchangeably. I also

[2]Uppsala, Lund, Göteborg, Stockholm, and Umeå universities. Linköping university already offered a wide range of programs but got the official status of a university in 1975.

do not distinguish between specialized universities or those providing education in all academic fields throughout this paper, unless stated otherwise.

Due to the size of the country, having only seven locations offering access to tertiary education means that a substantial part of the country lives relatively far away from the closest university. In 1970, the (population-weighted) average distance to the next college was over 80km.[3] Since education including post-secondary education is traditionally free of tuition fees in Sweden (Deen, 2007), the (lack of) geographical access was seen as a major college education friction. Politicians feared that such distances impose a prohibitive high economic, social or psychological cost to attend college education for some (Premfors, 1984). Therefore and due to the generally increasing number of students, the government decided to establish a significant number of new HEIs in the 70s.[4] The Luleå University of Technology was already founded in 1971. But the substantial change in the higher education landscape in Sweden happened in 1977 when 14 new HEIs were established in 14 different locations where no university was operating before.[5] From 1977 on, there was a total of 22 municipalities with at least one HEI offering access to tertiary education. As intended by the government, this massive expansion more than halved the average distance to the closest college to below 40km.[6] It was not just the average impact that was notable, but also the share of the Swedish population that was affected by the reform. In 1970, roughly 40% lived under 50km away from the next university. In 1977, that share jumped up to almost 70%.[7]

After that, six more universities were established, again in municipalities without any HEI until then: Halmstad University in 1983, Blekinge Institute of Technology in Karlskrona in 1988, University of Trollhättan/Uddevalla in Trollhättan in 1990, Södertörn University in Huddinge, again a part of the larger Stockholm area, Malmö University as well as Gotland University in 1998. Figure 1 shows the "new" structure of tertiary education in Sweden where municipalities with new colleges are represented in dark blue. Notation-wise, I will refer to universities that existed already before 1970 as "old" universities and the according municipality as "old uni" municipalities. Equivalently, colleges established after 1970 are termed "new" universities and their municipalities "new uni" municipalities. The "new" colleges started with relatively low numbers of enrolled students as shown in Figure 2 and

[3]The average distance to the closest HEI over time is also visualized in Figure A.1 in the Appendix.

[4]See e.g. Varga (1998) and Anselin et al. (1997) for a review on the growing number of students.

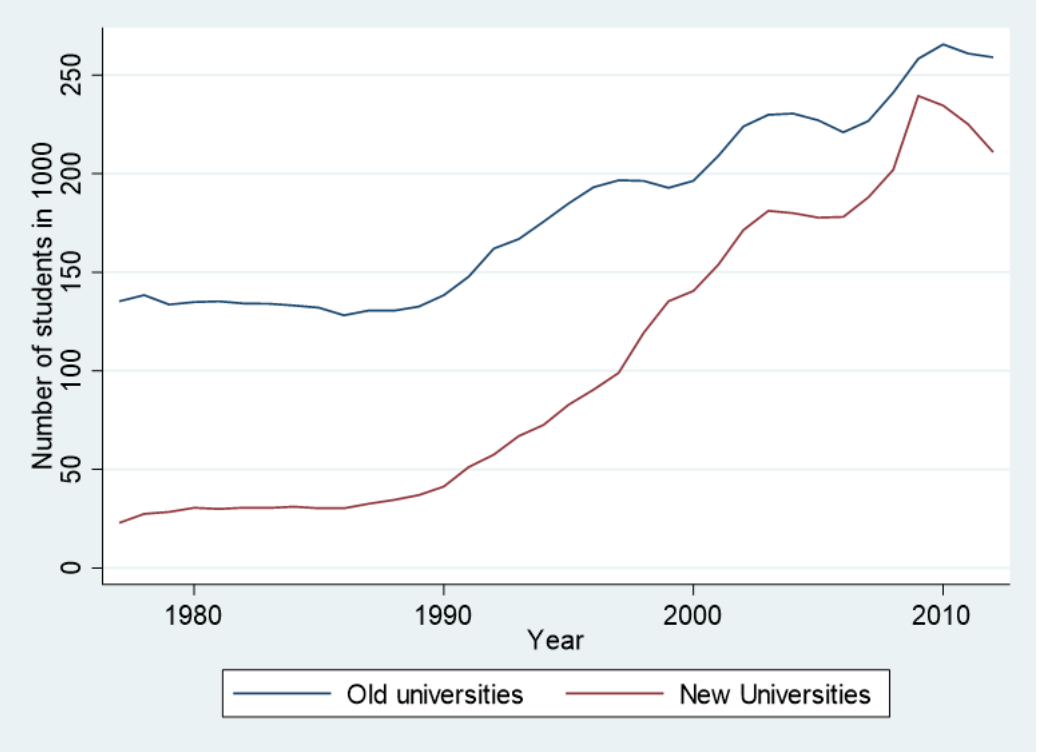
[5]The 14 municipalities receiving a HEI in 1977 were Jönköping; Vaxjö; Kalmar; Kristianstad; Borås; Skövde; Karlstad; Örebro; Västerås; Falum; Borlänge; Gävle; Sundvall and Östersund.

[6]See Figure A.1 in the Appendix for a visualization.

[7]The full dynamic is visualized in Figure A.2 in the Appendix.

did not start to catch up until the 1990s.

Figure 2: Number of students enrolled in universities



Notes: "Old" universities were founded before 1968 and "new" universities after 1968.

As mentioned above, one of the political goals of the Swedish college expansion reform was to make post-secondary education more accessible, geographically as well as socially (Andersson et al., 2004). The reasoning was to reduce education frictions by lowering the costs of migration or commuting, something that might affect those from lower social classes stronger. The unofficial slogan of the enabling legislation for the initial expansion in 1977 (Swedish Government, 1977) was "En hogskoleenhet i varje ort", which roughly translates to "a unit of higher education in every locality". It can not be ruled out entirely that other factors like regional economic or demographic characteristics have played a role in the locational choices of the new institutions. However, interviews with responsible policymakers of that time (Andersson et al., 2009), as well as the reports of the responsible commissions (Premfors, 1984), confirm the hypothesis that geographic dispersion of access to higher education was the primary objective when choosing the locations. Table 1 compares "new uni" municipalities (column 3) in 1970 before the first new HEI was opened in 1971, with other potential candidates for a new college, i.e. municipalities without any HEI (columns 4 and 5), as well as with "old uni" municipalities (column 1) and their catchment area (column 2). In line with the above-described

Table 1: Full Swedish population by treatment group in 1970

	Old	Old Catchment	New	New Catchment	Never uni
Distance to uni (km)	0	27	112	109	146
	(0)	(12)	(70)	(43)	(93)
Pop density	2,142	313	327	38.72	41.63
	(1,692)	(525)	(587)	(26.44)	(73.25)
Remoteness	310.76	313.91	354.31	307.81	425.56
	(78.41)	(65.4)	(118.62)	(80.26)	(203.77)
Age	31.42	28.6	30.5	31.4	31.93
	(19)	(19)	(19.41)	(20.28)	(20.43)
Pop share 18y	0.016	0.015	0.017	0.017	0.18
	(0.0008)	(0.0022)	(0.0013)	(0.0015)	(0.0023)
Mobility (past 2y)	0.042	0.073	0.041	0.038	0.035
	(0.199)	(0.259)	(0.2)	(0.192)	(0.183)
College	0.25	0.23	0.21	0.17	0.17
	(0.43)	(0.42)	(0.41)	(0.37)	(0.37)
N	1,318,525	1,129,965	1,409,444	1,273,169	1,605,757

Notes: Old: Municipalities with universities established before 1968; Old Catchment: Municipalities without university but where a university was established before 1968 within 50km; New: Municipalities with universities established between 1968-2012; New Catchment: Municipalities without university but where a university was established between 1968-2012 within 50km; Never uni: No university until 2012. Remoteness is the population-weighted sum of all distances to all other municipalities. High remoteness means that a region is relatively far away from the rest of Sweden's population. Age, mobility, and college are population-weighted averages. Mobility measures the share of people that moved at least once between municipalities in 1968 and 1969. College is the share of the 1970's population that already has a college degree or will attain a college degree at some point. Therefore, it also includes future education outcomes. Standard deviations in parentheses.

objective of dispersion, the new colleges were established in municipalities that had, on average, a high distance to the closest "old" university.[8] However, compared to other municipalities outside of the catchment area of "old" colleges, the distance is not significantly different. In contrast, the "new uni" municipalities' population density is higher and remoteness, defined as the sum of population-weighted distances to all municipalities, is lower than in other municipalities without a HEI in 1970.[9] That emphasizes the importance of municipality-level fixed effect to control for level differences between municipalities, as will be discussed later.

Indicators regarding the population show only little differences. People living in "new uni" municipalities were similar in terms of age, both on average and in the population share of 18-year-olds.[10] The probability to move at least once during

[8]Distance is measured between the centroids or mid-points of the municipalities.

[9]A higher value in remoteness means that people in that region live relatively far away from the rest of the Swedish population.

[10]Comparing Figure A.2 and Figure A.3 in the Appendix provides additional evidence that my study population of high school graduates is similarly distributed as the total population when it

the two years before 1970 was only slightly higher in "new uni" municipalities. Inhabitants of "new uni" municipalities had a higher likelihood to have a college degree at some point in their life compared to those in other municipalities that did not have a university. But it should be noted that the measure includes future education outcomes, which might include outcomes of the reform already. The used data will be described in more detail in the next section.

comes to distance to the closest HEI.

3 Data

3.1 Individual-Level Data

To investigate the effect of changes in access to higher education, I need to observe individuals before they decide to go to college. In Sweden, students have to choose one of several national programs if they apply for secondary education after the 10th grade. Until 1993, the vocationally orientated programs had a duration of two years while those meant to prepare students for university education took three years. Only the latter ones made students eligible to enroll at a university before the duration of the vocational programs was extended to three years as well in 1993. Therefore, it has always been necessary to finish 13 years of schooling before entering a university, which is usually the case in the year students turn 19.[11] Hence, my base study population consists of the full Swedish population born between 1950 and 1990 who finished at least secondary education.[12] I combine several Swedish administrative records. The data used in this paper comes from the Swedish Interdisciplinary Panel (SIP), administered by the Centre for Economic Demography, Lund University, Sweden.

The register of the total population, available from 1968 onward, includes yearly information on the municipality of residence and links to spouses and parents. The place of residence is a central variable in my analysis. It is defined as the municipality in which the individual was registered by the end of the year. A notable concern is that people might not live at the place where they are registered. There is anecdotal evidence, for example, that young adults move out of their parent's homes without registering the new address. That would result in an underestimation of mobility and incorrect assignments to the treatment status. However, it should be noted that the law requires citizens to register their place of living and non-compliance is penalized.

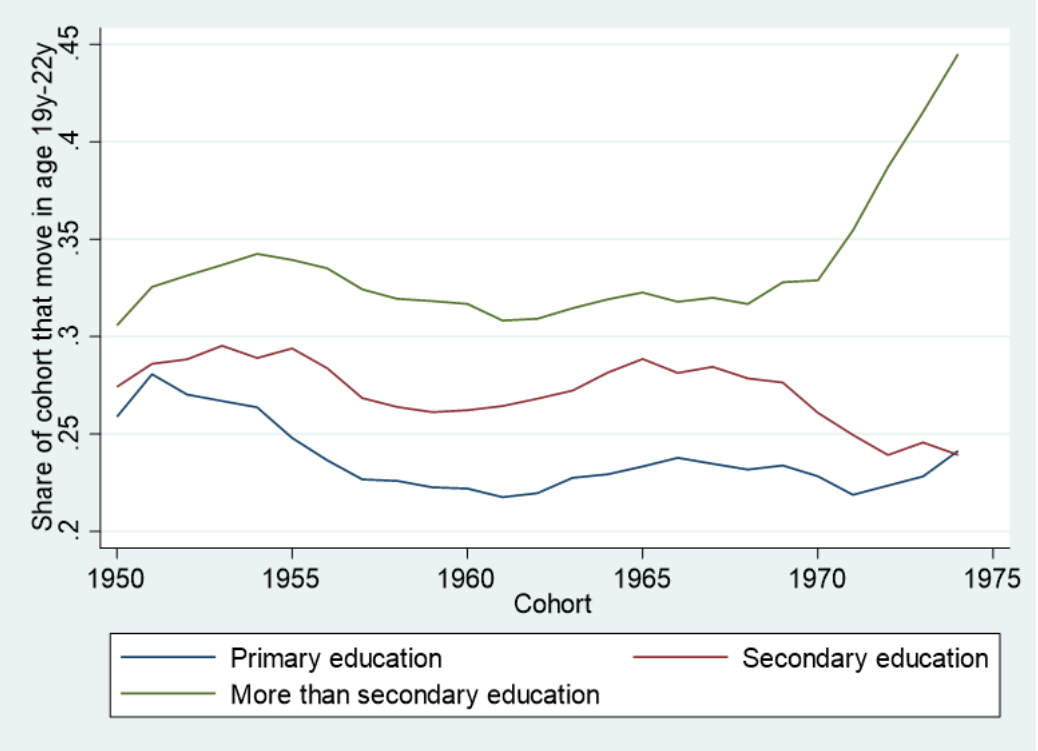
Using the information on the municipality of residence, I construct one of my two main outcome variables. To answer the question of whether a change in access to higher education changes migration decisions, my main focus lies on the few years after graduating from high school. During that time, graduates decide whether to apply to a university to attain a college degree and if so, which university they pick. To investigate migration behavior in that crucial period of life, I generate a dummy

[11] See Deen (2007) and Fischer et al. (2020) for more details on the Swedish education system.

[12] The cohort born 1950 turned 18 in 1968, which is the first year where I can observe (among others) the municipality of residence. I cannot use older cohorts, since the first time I observe their place of living is after they (potentially) moved out of their place of schooling.

that equals one if an individual changed her municipality of residence at least once in the four years after finishing secondary education i.e. moving from the place where she lived during high school graduation. The development of mobility during early adulthood is displayed in Figure 3 by the level of education. The graph confirms

Figure 3: Early adulthood mobility by level of education



Notes: Share of each cohort that moves at least once between age 19 years - 22 years over time by the highest level of education.

the stylized fact that education and mobility are positively correlated, even before the highest educational degree is completed. In addition, the difference between the educational groups is increasing over time. While the low educated of the cohort born in 1950 are about 5%-points less likely to move as young adults than those who attain a college degree in their life, the difference almost doubles to 9%-points in the cohort born in 1962.

I construct a proxy for migration costs with the provided link to parents. Previous research has shown that individuals who live in the same location as their parents and grandparents have a lower probability of moving away, all other factors constant, since the social costs of moving are higher (see for example Mulder and Malmberg (2014) for Sweden). This allows me to split the sample into individuals with low migration costs (without local family ties) and high migration costs (with local family ties).

The birth register contains information on the year of birth, gender, and place of birth of the full population.

Data on earnings are taken from the official tax register based on official tax returns. Hence, it is only available on a yearly basis. The exact definition follows Edin and Fredriksson (2000). Consumer Price Index (CPI) adjust incomes to SEK in 2011.

Information on the highest achieved level of education is provided by the educational register. It allows me to distinguish between only primary and lower secondary (less than 13 years of schooling; not eligible for college education), upper secondary (13 years of schooling), and (some) tertiary education (more than 13 years of schooling). The latter two groups build the study population for the main specification. However, the decision to finish upper secondary education may depend on access to tertiary education as well. Hence, the first two groups are used for robustness tests. The education register was recorded in 1990 for the first time and includes all degrees obtained until 2019. Therefore, individuals who died before 1990 are not covered. This is primarily a problem for the parents of the study population. To complement information on parents' education as well as economical background the Swedish Census of 1970 was added whenever information from the educational register is missing. In contrast to the education register, information in the Census is based on self-enumeration and refers to October 1970 instead of the status in 1990, which might explain little differences. It should be emphasized that the register data provides some information on the time when the highest degree was obtained, but only for a relatively small sub-sample of the total population. Hence, all information on education obtained from the educational register is time-invariant and represents only the highest educational degree. The Census of 1970 does not necessarily contain the highest educational degree, but the highest degree obtained by October 1970. Nevertheless, information from the census is mainly used to complement information for individuals who died before 1990 and therefore can be expected to have completed their educational careers at the time of the census.

3.2 University and Municipality Data

To analyze the effect of university openings, the time and location of these openings are crucial. I mainly follow a report of the Swedish National Agency for Higher Education (*Högskoleverket*) on the Swedish higher education landscape from 2006 (Högskoleverket (National Agency for Higher Education), 2006). However, the official founding year is not always the year in which a higher education institution (HEI) becomes a notable provider of tertiary education. For that reason, infor-

mation from the Higher Education Register (*Högskoleregistret*) on the number of enrolled students and own research was added to determine the de-facto start of a new college. Throughout this paper, a HEI is considered as such if it is labeled as a university or university college in the report of the National Agency for Higher Education, offers (at least) undergraduate education in more than one field, or has more than 500 students enrolled. That excludes specialized HEIs like nursing, military, or theater schools.

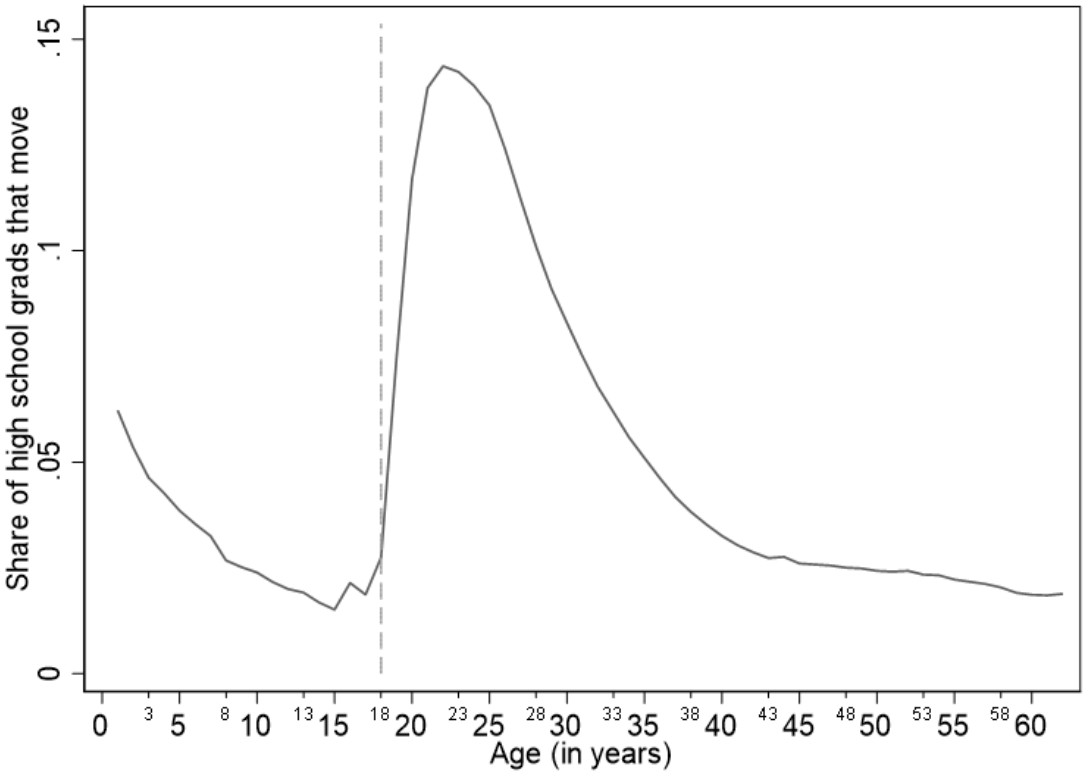
The location of the main campus is linked to the respective municipality, where I use centroids to determine the distance to other municipalities and their inhabitants. All municipalities are defined in the administrative borders of 1977 to keep the borders constant over time. That leaves 277 municipalities of today's 290. In case a university has numerous branches in different locations or more than one campus, only the location of the main campus is considered. The only exception is secondary campuses which were independent universities and continued to host a sizable number of students after a merger. Given that rule, there are no university closures between 1968 and 2012.

3.3 Assigning Treatment Status

An individual is part of the treatment group if she lived in a treated municipality **before** finishing high school. As mentioned above, students usually finish higher secondary education in the year they turn 19. For that reason, individuals are assigned to the treatment or control group according to the treatment status of their place of residence in the year they turn 18 in the main specification. Figure 4 visualizes the likelihood to move by age within my sample. Although mobility starts to increase with the age of 15 years already, the big jump is exactly after turning 18 years, supporting my approach to assigning individuals to municipalities in the year of turning 18 years.

The treatment status of a municipality depends on the distance to the closest HEI. In general, there are five different groups of municipalities: (1) "Old uni" municipalities already have a HEI at the beginning of the observation period in 1968 and therefore always have a distance of 0km. (2) The catchment area of these "old uni" municipalities includes municipalities that have a distance below a certain threshold throughout the whole observation period. These two groups are usually referred to as always-treated municipalities. (3) "New uni" municipalities are municipalities without a university in 1968 but where a new HEI has opened afterward (i.e. the

Figure 4: Propensity to move by age



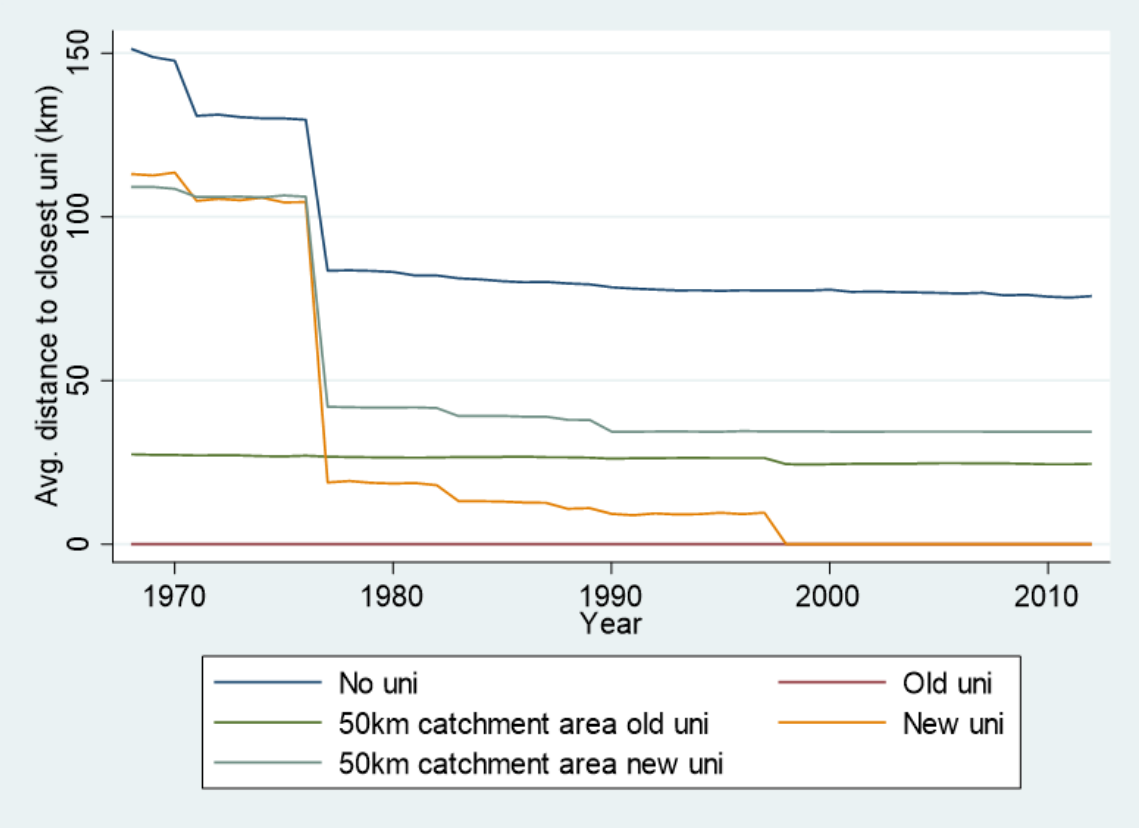
Notes: Propensity to move between municipalities by age. All individuals born between 1950 and 1990 with (at least) secondary education are included.

distance to the closest HEI dropped from above 0km to 0km).[13] (4) Equivalently to the "old uni" municipalities, the "new uni" municipalities have their catchment area as well. In general, groups 3 and 4 are the treatment regions, depending on the specification. (5) Finally, all municipalities that always have a distance above the catchment area threshold are considered never-treated municipalities. Figure 1 provides a geographical overview of the five groups for a catchment area threshold of 50km.

There might be changes in the distance to the closest university for some municipalities of the never-treated group as can be seen in Figure 5. However, these changes are considered non-relevant when it comes to education and migration deci-

[13]Depending on the size of the catchment area, there are two municipalities (Malmö and Huddinge) that belong, by definition, to group 2 *and* 3. They are classified as part of group 3 in the main specification. Treating them as always-treated (group 2) and dropping them from the sample does not change the results, as shown in section C.2.

Figure 5: Distance to the closest higher education institution



Notes: Population weighted average of the distance to the closest higher education institution, by treatment group. The population weights only use the 18 years old population. The exact definition of the treatment groups is described in section 3.3.

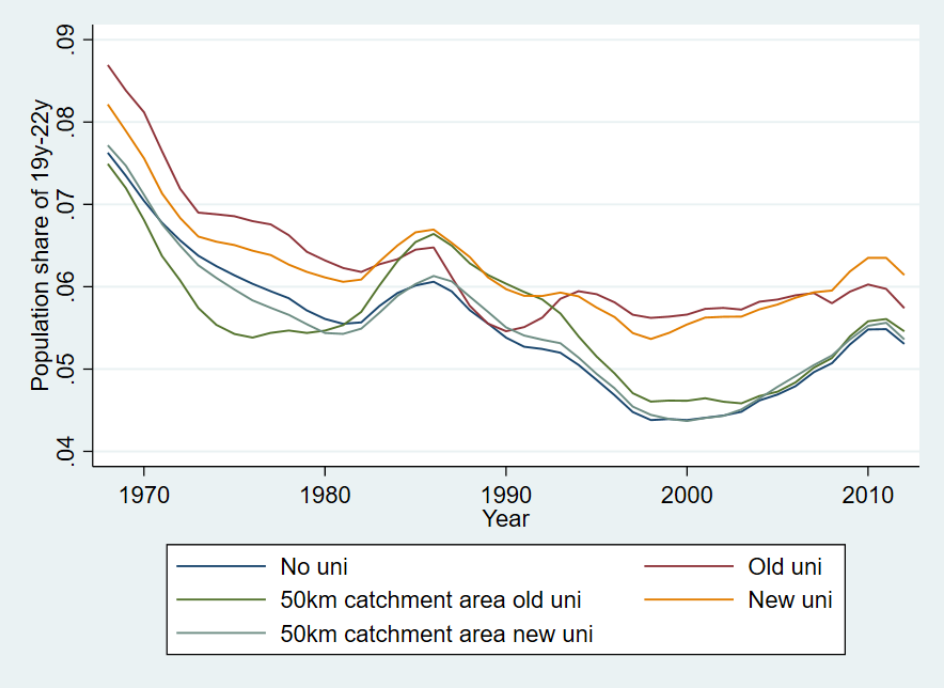
sions, either because the changes are very small in magnitude or because the distance is very sizable even after the drop. Individuals graduating from high school in these regions are making up the control group. Section C.3 in the Appendix shows that the main results do not depend on the definition of the catchment area threshold. The exact empirical strategy including the underlying assumptions is discussed in section 4.

3.4 Comparing the Treatment Groups

I already used the same definition of treatment groups before in Table 1 where I compare the treatment groups before the first "new" university opened in 1971. When comparing the municipalities over time, the distribution of young adults gives some potential descriptive evidence of changes in migration patterns in early adulthood. Figure 6 plots the share of 19 - 22 years old residents by treatment groups

defined above. In 1970, before any of the new HEI were opened, roughly 8% of the population in "new uni" municipalities were between 19 and 22 years old. That is somewhere between the 7.5% of young adults in other municipalities without a university and the 8.4% in municipalities with an "old" institution. When the trends start to diverge in the 1970s, the share of young adults in "new uni" municipalities begins to converge to the level of "old uni" municipalities and closed the gap already in the 1980s.

Figure 6: Population share of young adults



Notes: Population share of young adults (age 19 years - 22 years) over time, by treatment group. The exact definition of the treatment groups is described in section 3.3.

4 Empirical Strategy

I exploit the variation in access to higher education caused by openings of new universities to provide causal evidence for the relevance of geographical distance to HEIs on the education and migration decisions of young adults. As mentioned above, the higher education expansion led to a massive drop in the average geographical distance to tertiary education.[14] However, Figure 5 documents a notable variation between the groups of municipalities defined in the section above, which is exploited in this paper. Since outcome variables as well as the treatment status are defined to be constant over time, my sample can be described as a repeated cross-section consisting of cohorts of 19-year-old high-school graduates born between 1950 and 1990.[15] As the treatment (the opening of a new college) happened in different years, I estimate the dynamic treatment effect using a staggered Difference-in-Difference (DiD) or event-study design. In line with the most recent development regarding two-way-fixed-effect estimation (See Roth et al. (2022) and Chaisemartin and D 'Haultfoeuille (2022) for an overview), I exclude treated observations from the control group. However, not-yet-treated observations are part of the control group to increase the statistical power. I follow the approach of Gardner (2022) with the event-study regression equation

$$Y_{ist} = \lambda_s + \gamma_t + \sum_{r \neq -1} \beta_r D_{isr} + X_{ist} + \epsilon_{ist}, \tag{1}$$

[14] See also Figure A.1 in the Appendix.

[15] My period of observation is 1968-2012. For the assignment of the treatment status, I need to observe individuals in the year they turn 18. Therefore, the first cohort I included in the sample is born in 1950. The upper end of my sample is limited by outcome variables that require me to observe individuals up to the year they turn 22.

where individual i graduates in municipality s in year t.[16] Y_{ist} is the outcome of interest, for example, a college degree dummy or a dummy indicating whether an individual moved in the year of graduating from high school or three years after. $r \in \{-9, ..., -2, 0, ..., 16\}$ indexes the relative time-wise distance from the treatment and D_{isr} are indicators of treatment adoption.[17] D_{isr} equals one if person i graduates in a treatment municipality r years **after** the new university was opened for $r \geq 0$. Equivalently for the case $r < 0$, D_{isr} is zero for individuals completing secondary education while living in a treatment municipality $|r|$ years **before** the new university is established. For young adults that graduate from high school in control municipalities, $D_{isr} = 0 \; \forall \; r$. The coefficients β_r capture the dynamic treatment effect of interest for $r \geq 0$, while they can be used as evidence for the plausibility of the parallel trend assumption before the treatment (i.e. when $r < 0$). λ_s and γ_t are municipality and time or cohort fixed effects. The former controls for all time-invariant differences between municipalities, while the latter controls for national trends. Therefore, the coefficients are estimated by exploiting the variation between units *and* time only. Intuitively, coefficient β_r captures the change in the level-difference between treatment and control group r years after (or before if $r < 0$) the intervention, relative to the difference in a reference period. Here, the reference period is $r = -1$, i.e. one year before a new college is opened. Or more precisely,

[16] It should be emphasized here that there is a difference between the year where I assign individuals to the place of residence and the year of (potential) treatment. As noted in section 3.3, I use the place of living in the year individuals turn 18 to ensure I do not pick up a move right after finishing high school already. Nevertheless, the actual year of potential treatment is the year t where graduates turn 19, which is the year they finish secondary education. Therefore, the place of residence in the year of turning 18 is a proxy for the place of high school graduation. This is based on the assumption that there is no movement in the year of graduation before secondary education is actually finished. However, taking the year of high school graduation as the period of potential treatment is especially important for cohorts turning 19 around the time the HEI is opened and, therefore, for the reference cohort. Take a cohort of high school graduates born in 1968, who turn 18 in 1976 in a municipality that is treated one year later, in 1977. If I would use the year where observations turn 18 as the year of (potential) treatment, these individuals are considered as not-yet-treated since they live in a treatment municipality in the year before the treatment happens, i.e. the university opens. However, that is only true for the year where I assign individuals to the place of residence, not the year where the young adults actually graduate from high school, which is 1977 when the new institution was already operating.

[17] The lower end of the observation window is limited by the time of the majority of variation, which happens in 1977. The first observed cohort, born in 1950, graduates in 1969, which is eight years before 1977. Coefficients for the relative years before that can be estimated as well, but they rely on a fraction of treated observations only. This is an unavoidable problem of event studies that have an unbalanced panel by construction. For that reason, the endpoints of the interval are binned following Schmidheiny and Siegloch (2020): Let l index the non-binned relative time, then $r = -9$ if $l \leq -9$ and $r = 16$ if $l \geq 16$. In contrast to the lower end, the upper end of the observation window is limited due to economic reasons. To limit the problem caused by potential general equilibrium effects, the observation window ends after 15 years after the university was opened.

the cohort graduating from high school one year before a new university opens in their place is the reference cohort.

Following the logic of Gardner (2022), I obtain the coefficients by applying a two-stage approach. First, I estimate the model

$$Y_{ist} = \lambda_s + \gamma_t + X_{ist} + \epsilon_{ist} \tag{2}$$

on the sample of individuals that lived in control municipalities at the age of 18 (i.e. $D_{isr} = 0 \; \forall \; r$) to obtain the estimated municipality and cohort effects $\hat{\lambda}_s$ and $\hat{\gamma}_t$ while adding individual level controls X_{ist}. In a second step, the adjusted outcomes $Y_{ist} - \hat{\lambda}_s - \hat{\gamma}_t$ are regressed on $D_{isr} \; \forall \; r \in \{-9, ..., 16\}$ to identify the average effects $E(\beta_{isr}|D_{isr} = 1)$. By using that approach, I also control for potentially heterogeneous treatment effects (see Sun and Abraham, 2021; Roth et al., 2022).

Whether the estimates represent causal relationships depends on several identifying assumptions. The most important identifying assumption is the parallel trends assumption which states that the difference (in outcome) between the treatment and control group had to be constant over time in absence of the intervention. Or, in other words, the non-treated counterfactual of the treatment group is assumed to evolve in the same way as the control group. Here, it means assuming that cohorts graduating from high school next to a new HEI would have made similar education and migration decisions, on average, as students graduating in control municipalities if no new college were opened. There are several arguments why this assumption is likely to hold here.

First, I argue that in terms of my outcome variables, the new HEIs are as good as randomly assigned to locations, similar to other studies that use the same (Andersson et al., 2009; Nybom et al., 2022) or a similar (Suhonen and Karhunen, 2019; Berlingieri et al., 2022; Carneiro et al., 2022; Lehnert et al., 2020; Frenette, 2009) reform to obtain causal estimates as well. As described in section 2, the locations of the new universities were, to the best of my knowledge, only chosen according to geographical arguments. In addition, the descriptive evidence presented in section 2 indicates that population density might have played a role as well. However, since population density does not vary a lot over time the unit fixed effects absorb these kinds of level differences between municipalities. A comprehensible concern could be that the higher distance to the closest HEI *before* the reform could be correlated to a lower level of college education or a lower population share of young adults since they were forced to move away to study at a university. However, "new uni" municipalities are not significantly different along those dimensions, including the average distance to the closest university as displayed in Table 1. The quasi-random

choice of locations provides an institutional argument that there are no systematic differences between treatment and control regions. Therefore, I conclude that the allocation of the intervention (i.e. the location of HEI) were not depending on any of my outcomes.

Second, the rich data set allows the estimation of the so-called "pre-trend". A parallel treatment effect *before* the intervention provides additional evidence that the parallel trend assumption is satisfied. As will be visualized in the next section, the estimates for cohorts before a new institution is opened are mostly 0 for all outcomes and specifications. Third, the fixed effects absorb all observed and unobserved time-constant differences at the municipality level and any kind of national trends that affect all municipalities similarly. In addition, I can control for differences at the individual level like the parents' education and differences in migration costs by including family ties. However, my results do not depend on including these controls as shown in section C.1 in the Appendix.

Another important assumption is the Stable Unit Treatment Value Assumption (SUTVA) (Rubin, 1980). SUTVA is sometimes described as the assumption that each unit, including units from the control group, is only affected by its own treatment status. This implicitly rules out the relevance of general equilibrium and (spatial) spill-over effects. To minimize the influence of (local) general equilibrium effects I restrict the effect window to 15 years after a new institution was established. Since a new HEI might not only affect the access to education but also the local labor market, demographics, or local amenities of the location in the long run, the direct effect of the reform becomes harder to measure over time.[18] The exclusion of spill-over effects is traditionally problematic in spatial analysis (see Butts, 2021). A new HEI likely not only affects the location itself but also other regions close by since students could commute to the new college or consider moving closer to the location which they would not have done without the new university. For that reason, I exclude the catchment area of "new uni" municipalities from the control group.[19] Instead, several specifications are estimating the treatment effect for the catchment area while excluding the "new uni" municipalities themselves. To identify the reach of spill-over effects, I vary the size of the catchment area in Appendix section C.3.

[18] Before the intervention, the effect window consists of nine years, since that is the maximum number of years I can observe cohorts graduating from high school before the 1977-reform. Every (relative) year outside of that chosen effect window is included in the estimation by binning at the endpoints according to Schmidheiny and Siegloch (2020). The implicit assumption that there are no interventions outside of my observation window (ranging from 1968 to 2012) is unproblematic here since all universities ever existed in Sweden are known.

[19] As mentioned above, the catchment area is defined as all municipalities with a distance between the centroids being below a certain cutoff.

For "old uni" municipalities and their catchment areas, there is no change in the distance to the closest HEI, so it seems unlikely that there are spill-over effects from new universities opened further away than the one that was already there. However, students that would have enrolled at an "old" university may decide to apply at a new college, leaving an additional university place open at the "old" HEI. Also, academic staff like professors might relocate their workplace to a new college, which might also affect education and migration decisions of the local youth close to the "old" HEI. Hence, my main specification excludes the "old uni" municipalities (and their catchment area). To avoid the contamination of my control group by already treated units, I follow the latest development in the DiD / event-study literature by excluding treated observations from my control group (see Goodman-Bacon (2021) for an intuitive explanation of that issue). Finally, my control group consists of all high school graduates in municipalities that have a distance higher than the catchment area cutoff at the time of graduation. That includes both individuals in "never-treated" municipalities (treatment group 1) over the full observation period from 1968 to 2008 as well as high school graduates in treated municipalities (treatment groups 4 and 5) before the new university was opened. Note that, as shown in Figure 5, some of the so-called "never-treated" municipalities experience a drop in the distance to the closest HEI due to the reform as well. For the SUTVA to hold, I assume that a drop to a distance of more than the cutoff, for example, a drop from 120km to 90km, does not affect the migration and education decisions of young adults.[20]

If the above-mentioned assumptions hold, my estimates represent the Average Treatment Effect on the Treated (ATT) (Lechner, 2011). The estimated coefficients have to be interpreted relative to the reference period one year before a new HEI was opened and indicate the change in the difference between average outcome levels of the treatment and control group.

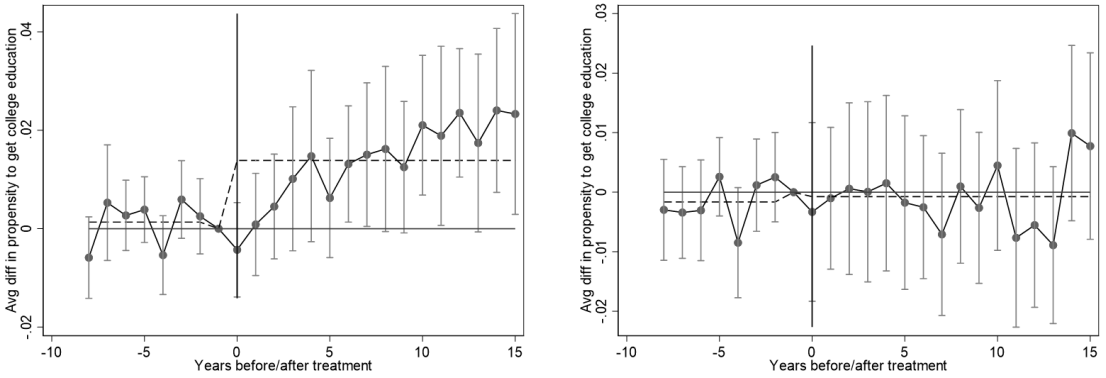
[20]Varying the threshold of the catchment area definition provides evidence that there is no treatment effect on municipalities beyond 50km. You find more details on that in section C.3 in the Appendix.

5 Main Results

5.1 College education

Figure 7: Propensity to obtain a college degree

New uni municipality | 50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

The first question that arises when investigating the effect of a higher education expansion reform is whether it had an effect on individuals' decisions to enroll at a HEI. Figure 7 shows the estimates of the main specification for "new uni" municipalities on the left-hand side. Individuals graduating from high school in "new uni" municipalities after a new college was opened have, on average, a 1.4%-points increased propensity to attain a college degree compared to the difference between treatment and control cohorts before the intervention. This corresponds to an average expansion in college education by 6.6%. The effect is increasing over time and becomes statistically significant on conventional levels five years after the treatment. The dynamics can be explained by the growing number of enrolled students shown in Figure 2. The sign of the effect is in line with previous findings of Alm and Winters (2009), Frenette (2004), Sá et al. (2006), and Jepsen and Montgomery (2009) who documented a negative relationship between the distance to the closest university and tertiary education participation rates. Frenette (2009), who similarly investigates the effect of a reduction in the distance due to newly opened universities, finds comparable results also in magnitude.

However, I only find a negative relationship between geographical distance and participation rates in "new uni" municipalities and small and/or very close neighboring

regions.[21] In contrast, the 50km catchment area of "new uni" municipalities shows no effect of a new HEI on college education as visualized on the right-hand side of Figure 7. It seems that the existence of the new universities close by did not change the decision of whether to apply for college or not during the first 15 years after opening. That could be explained in two ways. On the one hand, the distance to the closest university might not have been an incremental part of the costs of attending college for high school graduates in the catchment area. This explanation seems unlikely given the fact that the new university has an effect on college education in "new uni" municipalities and smaller catchment areas. On the other hand, it might be the case that the improvement in access to tertiary education is not enough to overcome the prohibitive costs in the 50km catchment area, while it is sufficient for some in the "new uni" municipalities. Note that the result does not necessarily mean that there was no impact on high school graduates in the catchment area at all. First, results only indicate that the effect does not differ between graduates in treated and control municipalities. Second, it is still possible that the new HEI acted as a substitute for old universities, i.e. that high school graduates that would have applied for a place at an old institution chose the new local college instead to attain college education. Previous publications have already shown that geographic distance is an important determinant for institution choice (see for example Gibbons and Vignoles, 2012; Griffith and Rothstein, 2009).

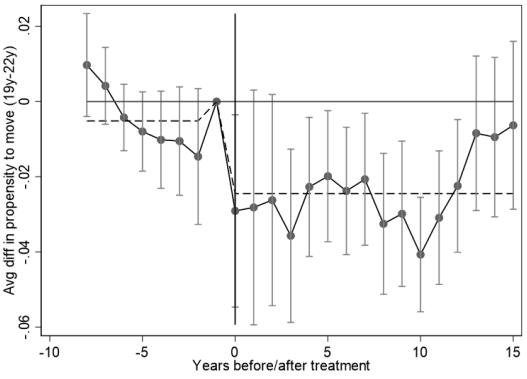
5.2 Short-Term Mobility

The effects of the college expansion reform on the mobility of young adults at the age of 19-22 years are heterogeneous with regard to geographical distance to the new institution. I find negative and partially statistically significant effects for individuals graduating from high school in "new uni" municipalities as depicted in Figure 8 on the left-hand side. Compared to the control group, the new HEI makes young adults 2.4%-points less likely to move away, on average, which corresponds to a reduction of the propensity to move by around 10.1%. The sign is in line with the intuitive expectation. High school graduates that would have moved away to attend college have the opportunity to stay in their home region after the new HEI opened. However, the effect is not persistent, starts to decline ten years after the HEI opened and even becomes insignificant by the end of my observation period.

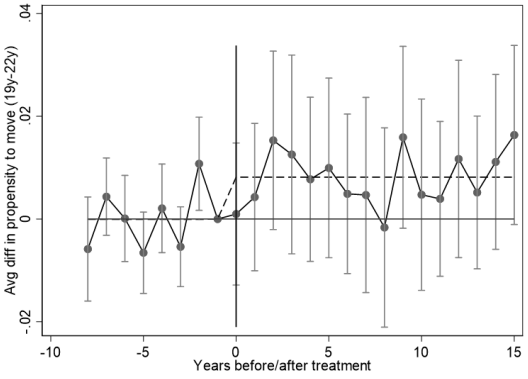
[21] As shown in section C.3 in the Appendix, there is a significant positive effect on college attendance rates in the 30km catchment area. That means that a drop in the distance to the closest university from above 30km to below 30km increases the likelihood of local high school graduates participating in tertiary education, even if the new institution was opened in the neighboring municipality.

Figure 8: Propensity to move with 19y-22y

New uni municipality



50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

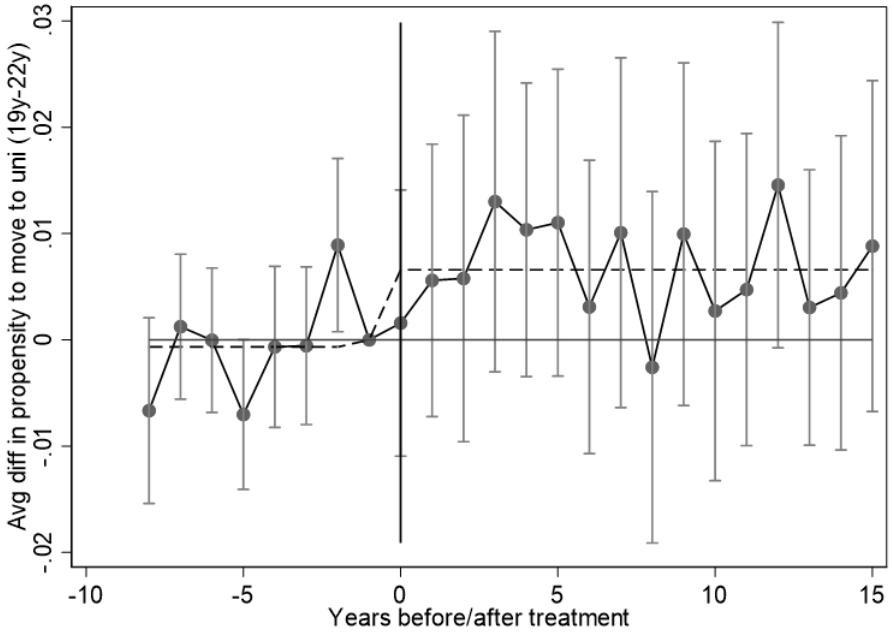
For students finishing high school in the catchment area of a "new uni" municipality, results differ notably. For cohorts finishing high school within 15 years after a new HEI opened within a distance of 50km (but still in a different municipality), I find an increased probability to move out of the municipality at age 19 years to 22 years of 0,8%-points on average as visualized in the right graph of Figure 8. Even though the estimated effect is not statistically different from zero, the reverse sign of the coefficients compared to the "new uni" municipality specification is striking. While high school graduates from "new uni" municipalities are less likely to move away, young adults in the catchment area show, if anything, a higher propensity to move.

The results are similar when considering moves from the catchment area to the close municipality with the new college rather than any move out of the municipality of graduation as before, visualized in Figure 9. Young adults are more likely not just to leave their home region in the catchment area of a new local center of tertiary education, but they are indeed moving towards this new local center.

5.3 Long-Term Mobility

To investigate mobility at later stages of the life cycle, I need to observe individuals longer than for the short-term mobility outcome above. Therefore, I restrict my sample further to cohorts born between 1950 and 1972 to be able to track every

Figure 9: Propensity to move towards a university with 19y-22y in the catchment area



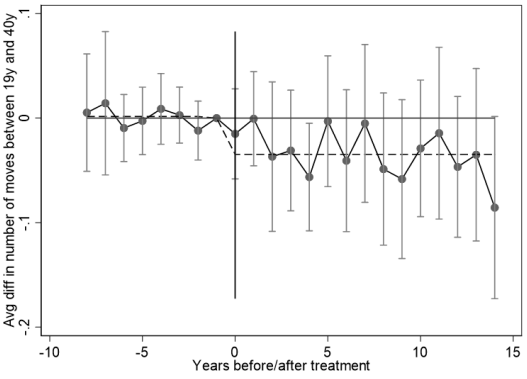
Notes: Treatment status assignment by treatment status of municipality of residence at age of 18 years. Treatment: drop in distance to closest higher education institution from above 50km to below 50km, excluding municipalities that got a new university. Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

individual's place of residence up to the age of 40 years.[22] Figure 10 shows the treatment effect on the number of moves between municipalities in the age of 19-40 years both for "new uni" municipalities and their 50km catchment area. While the sign is in line with results for short-term mobility presented above, the size of the estimates is very close to zero and statistically insignificant. Results are similar when estimating the effects on the distance between the place of residence at age 18 and 30 years using the same non-restricted sample as in section 5.2 (see Figure B.4 in the Appendix). Even if effects on individuals are only short-term with regard to migration, it does not mean there is no long-term impact. Since the out-migration of young adults is reduced while the in-migration of young adults increases, the population share of that group increases in "new uni" municipalities over time. Therefore, my results can explain the convergence of the share of young adults in "new uni" municipalities to the level of "old uni" municipalities described

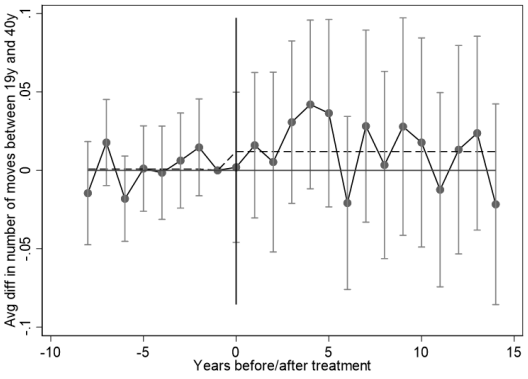
[22]That means, the last cohorts of the restricted sample turns 18 years in 1990, which is 13 years after the majority of new institutions were opened in 1977. For that reason, the observation window is also reduced to 13 years, while still being binned at the endpoints.

Figure 10: Total number of moves with 19 - 40 years

New uni municipality



50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

in Figure 6.

6 Conclusion

In this paper, I investigate the effects of access to tertiary education on the education and migration decisions of young adults in Sweden. To do so, I collect data on all universities and university colleges in Sweden, especially on those opened after 1968, and provide evidence that the change in access to education induced by the opening of new higher education institutions (HEIs) can be exploited to obtain causal estimates. I can conduct an event study on individual-level outcomes by combining several administrative Swedish register data sources.

My results indicate that there is a positive impact of opening a new HEI on college attainment rates among the local youth. The positive effect is limited to high school graduates who finished secondary education in municipalities that received a new HEI. I do not find strong evidence for spill-over effects to surrounding municipalities when it comes to educational outcomes, even though there was an improvement in access to tertiary education as well.

The effects on internal migration behavior differ between municipalities with a new HEI and their catchment areas, too. While a new university makes high school graduates in the same municipality less likely to move away, young adults become, if anything, more mobile after finishing high school in surrounding municipalities. The slight increase in the propensity to move is driven by migration toward universities.

For "new uni" municipalities, the results are in line with intuitive expectations: the new HEI reduced the costs of attending college and therefore increased the propensity of receiving tertiary education in that location. At the same time, high school graduates who would have moved away to another university had the opportunity to enroll at a HEI without leaving their home region, reducing mobility at the time of studying. However, I find evidence for long-term effects neither on location choices nor on overall labor-market mobility.

For the catchment area of "new uni" municipalities, effects are notably different. Although these regions experienced a drop in the distance to the closest HEI to below 50km, there was no effect on educational outcomes. Nevertheless, graduates showed a slight increase in the likelihood to move away to municipalities with universities. There are some candidates to explain how new universities attract young adults besides the direct educational channel. First, the new institution could have changed the local labor market. That could have happened either directly with the university as an employer but also indirectly via local multipliers (see Moretti, 2010).[23] Second,

[23]First estimations of income effects show no statistically or economically significant treatment effect as shown in section subsection B.3 in the Appendix. However, further research is necessary for a well-founded conclusion.

if friends from the same cohort moved to the neighboring "new uni" municipality to study instead of moving to an institution relatively far away, peer effects can impact graduates that do not enroll at a university themselves. Third, the growing population share of young adults might increase the supply of local amenities like a more dynamic nightlife or a bigger marriage market (Shapiro, 2006).[24] In any case, further research has to investigate whether effects on the local economy, social factors, or changes in local amenities could explain the change in migration patterns.

My paper emphasizes the importance of geographical distance when evaluating place-based policies. The measured effects of the reform are highly localized when it comes to educational outcomes. In terms of migration, the targeted region seems to benefit from the existence of a HEI while neighboring municipalities are, if anything, worse off. Therefore, policymakers should be aware of geographical limits as well as potentially negative spatial spillover effects when using place-based policies to foster the attractiveness of a specific location.

[24]Results for the population of lower educated young adults, who are not eligible to enroll in a HEI, provide additional evidence that these indirect effects play a role, especially in the catchment area (see section B.2 in the Appendix).

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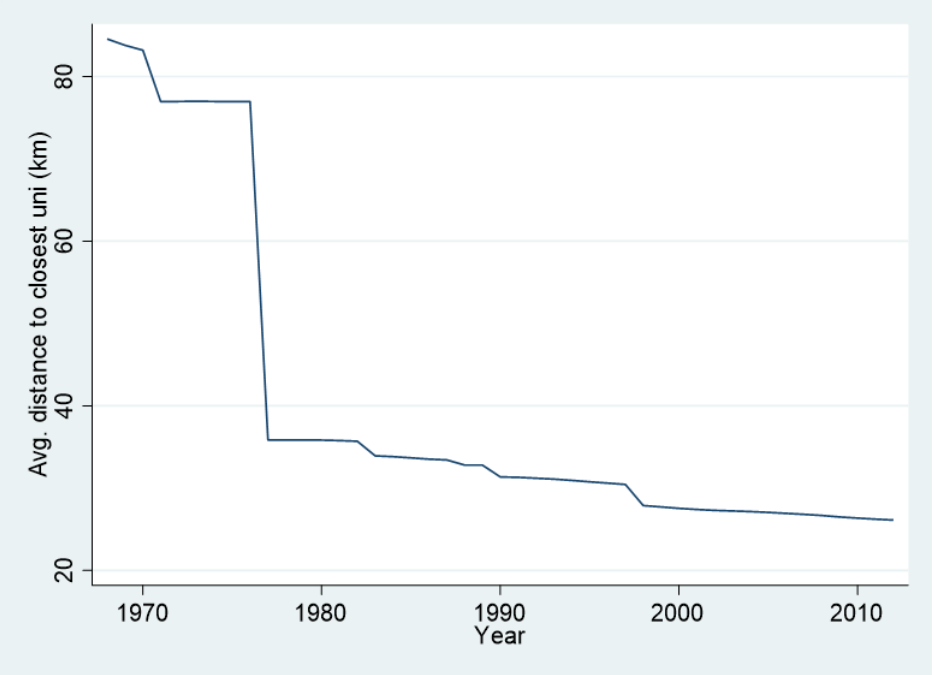
Appendix

A Distance to closest HEI

Figure A.1: Distance to the closest higher education

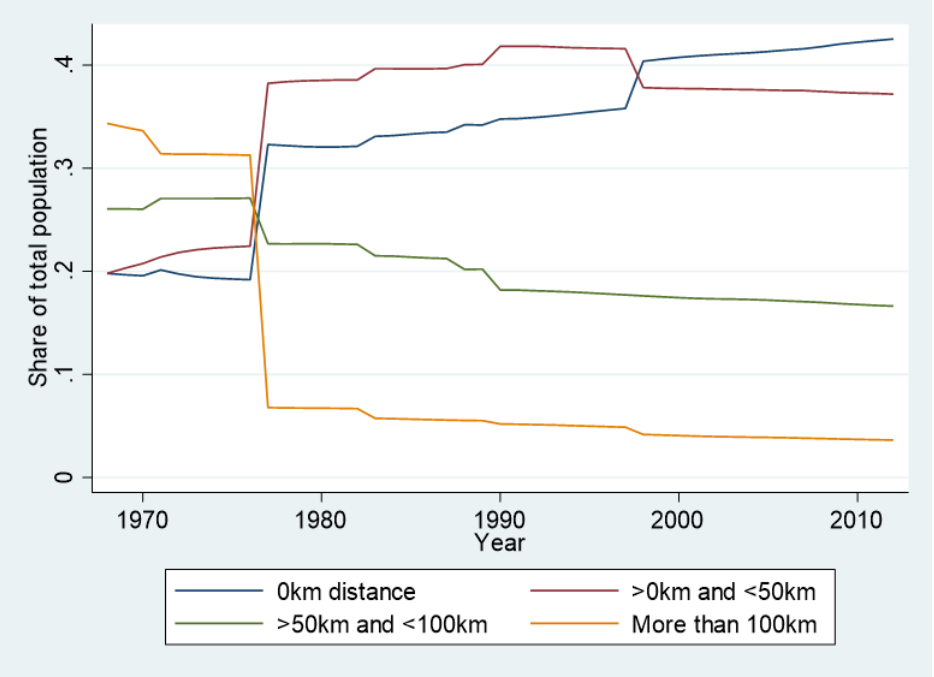


Notes: Population weighted average of the distance to the closest higher education institution. The population weights only use the 18 years old population.

Figure A.1 displays the aggregated effect of the university expansion reform on access to higher education for the population of 18 years old. While Figure 5 depicts the impact by treatment groups, Figure A.1 shows that the reform had a substantial total effect. An average 18-year-old Swede lived more than 80km away from the closest HEI in 1970 before the first new institutions opened. Already in 1977, the year of the main wave of the expansion reform, the average distance was reduced to less than half to under 40km, a distance that could theoretically be commuted. The distance reduces further afterward, but the main impact happened in 1977.

To learn more about how many residents were affected by the reform, Figure A.2 plots the share of the total Swedish population by distance groups. In 1970, only 20% of the total population lived in municipalities with a university or in the 50km catchment area, respectively. The former share increased to more than 30% in 1977, the latter almost doubled to roughly 40%. By definition, the share of the population that lived relatively far away from the closest HEI decreased at the same

Figure A.2: Share of total population by distance to closest university



Notes: Share of the total population by distance to the closest higher education institution.

time. Interestingly, the drop was much larger for the distance group of over 100km, emphasizing the stated goal of the reform to improve access to tertiary education, especially in areas where geographic access is low.

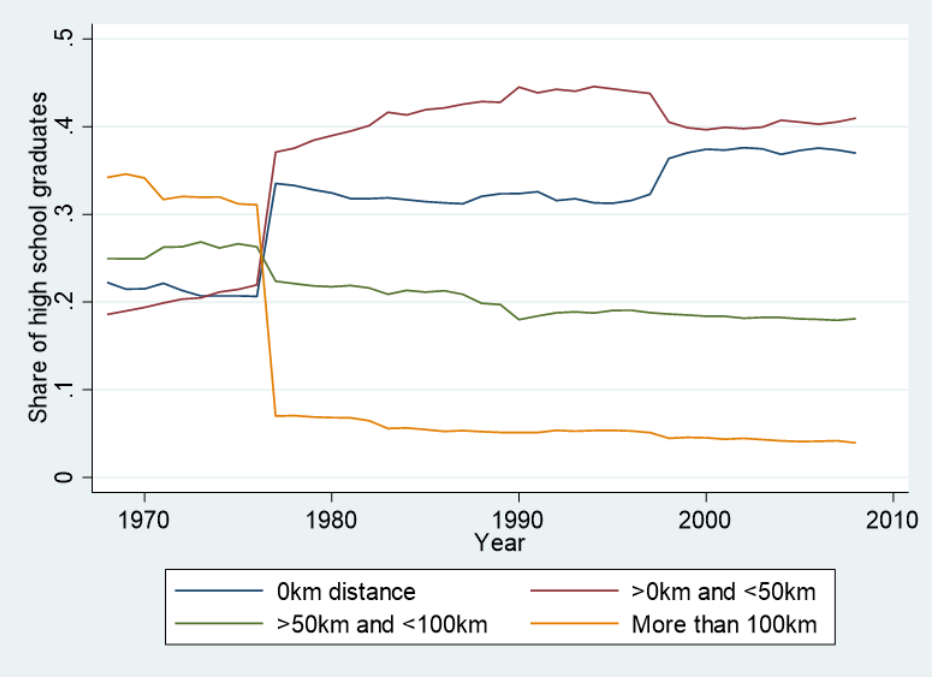
A similar pattern can be observed when only looking at the population of 18-year-olds that are about to finish high school as depicted in Figure A.3. The similarity of Figure A.2 and Figure A.3 also shows that my study population of high school graduates is similarly distributed as the total population in terms of distance to the closest HEI.

B Additional Results

B.1 Long-Term Mobility

Figure B.4 shows the effect on the distance between the place of residence at age 18 and age 30 years (in km). Although I measure a significant effect on mobility at age 19-22 years, there seems to be no measurable effect on location decisions after finishing a university education.

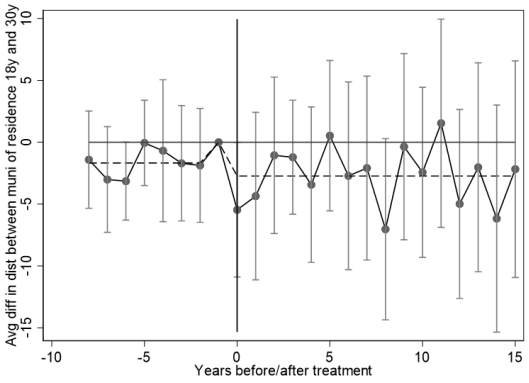
Figure A.3: Share of 18y old high school graduates by distance to closest university



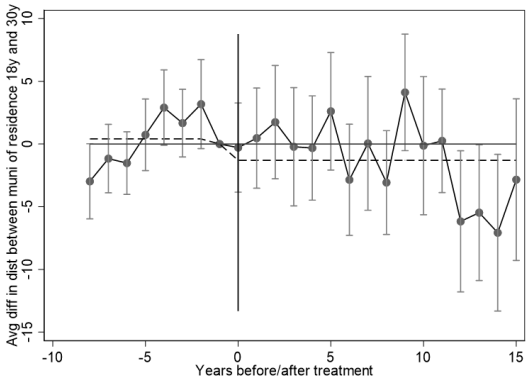
Notes: Share of the 18 years old population that will finish high school later by distance to the closest higher education institution. That subset of the total population is the sample for my main specifications.

Figure B.4: Distance between place of residence with 18y and 30y

New uni municipalities



50km catchment area of new uni



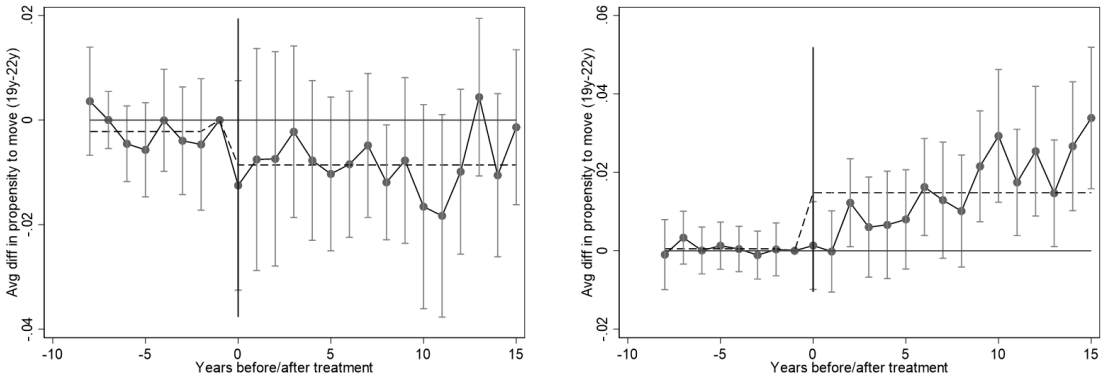
Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

B.2 Mobility of lower educated

Figure B.5 shows the treatment effect on the propensity to move at age 19-22 years for young adults with lower secondary education or less. Interestingly, the effects

Figure B.5: Propensity to move with 19y-22y

New uni municipalities | 50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with lower secondary education or less. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

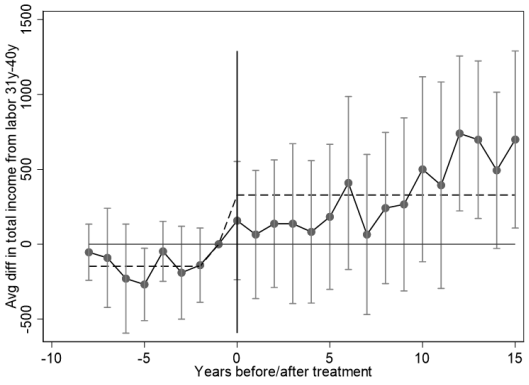
are similar in terms of the sign as for the higher educated of the main sample, although the population of this specification here is not eligible to enroll in a college. However, there are some differences in magnitude. In the "new uni" municipalities, the (negative) average treatment effect is closer to zero and becomes statistically insignificant. In contrast, the effect in the 50km catchment area is more pronounced and statistically significant on a 5% level. These results are in line with the results of the main specification. In the "new uni" municipalities, the negative effect on the mobility of high school graduates is driven by an increased college participation rate. Since young adults with lower levels of education are not eligible to enroll in a university, there is no significant effect on mobility. In the catchment area, however, the slightly positive effect on the mobility of high school graduates could not be explained by the direct effect of high participation rates in tertiary education. For neighboring regions, labor market effects, peer effects, or changes in local amenities are (relatively) more relevant. Since these indirect effects can apply to all residents, not just those who have a high level of education, there is a measurable impact on the migration patterns of young adults with lower education in the catchment area.

B.3 Income

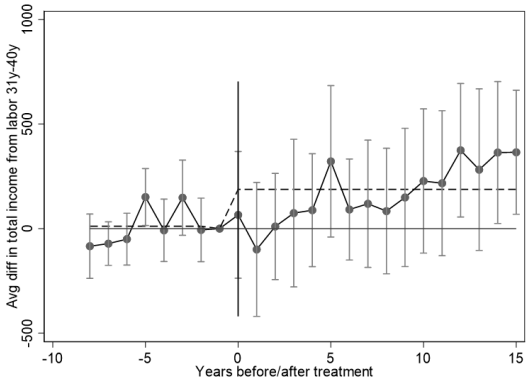
Figure B.6 shows the effect on average yearly income from labor in SEK (adjusted to CPI of 2011) that individuals earn in their 30s (age 31-40 years). When controlling for education there is a slightly positive but statistically and economically

Figure B.6: Change in the income of labor

New uni municipalities



50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Controls: parental level of education and own level of education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

insignificant positive effect, both in "new uni" municipalities as well as in the 50km catchment area. Given these results, the indirect effect of new HEIs via the labor market seem to be low in the 15 years after the new institution opened.

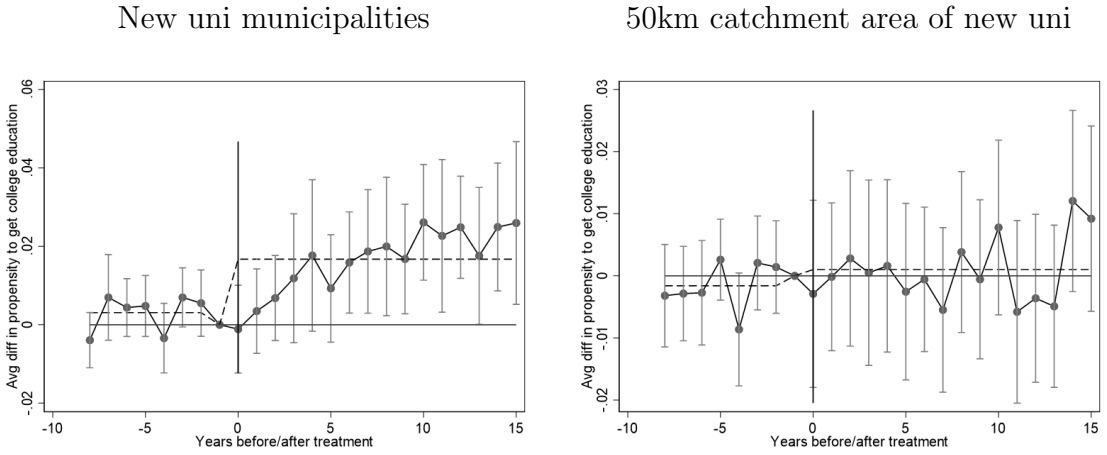
C Robustness Checks

C.1 Controlling for Parental Education

One important determinant of participation in tertiary education is the educational background of parents. If parents have a college degree, children are more likely to enroll at a university, all other factors equal. High school graduates from treatment and control groups are systematically different in the level of education of their parents, results presented above would be biased. In this section, I show that results do not differ when controlling for parents' education. It is defined as the level of the father's education (primary and no education, secondary education, or tertiary education and higher) or the mother's education if the father's highest degree is unknown. Since the educational register of Sweden does not cover information on individuals that died before 1990, I use the census of 1970 to add information on the highest degree for older cohorts. Figure C.7 plots the estimates for college education as the dependent variable, while Figure C.8 presents the results for mobility between 19-22 years as an outcome. Comparing the estimates with results from my main

specifications above, one can see that controlling for parents' education does not make a difference, presumably because the two-way-fixed-effects framework deals with potential (time-consistent) differences between treatment and control groups already.

Figure C.7: Propensity to obtain a college degree



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Controls: parental level of education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

C.2 Excluding Malmö and Huddinge from Treatment Group

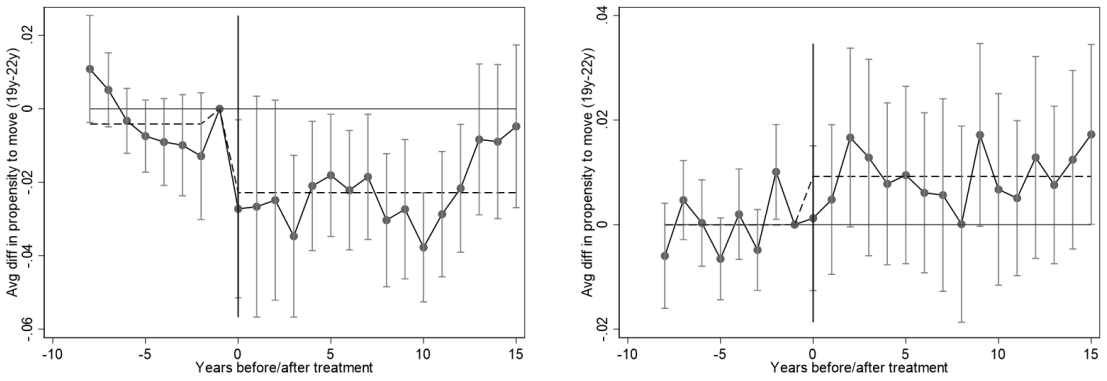
The municipalities of Malmö and Huddinge both received a new university in 1998. However, both municipalities were close to an old university even before that. While Lund is close to Malmö, Huddinge belongs to the greater area of Stockholm, although being its own municipality. Therefore, they could be assigned both to the group of treated as well as to the group of always-treated regions. Here, I choose the latter option, dropping them from my sample entirely. Figure C.9 and Figure C.10 show that results do not change compared to the main specification, where both municipalities belong to the treatment group.

C.3 Different Definitions of the Catchment Area

Which municipality belongs to which of the five treatment groups defined in subsection 3.3 depends on the threshold of catchment areas. A higher threshold includes more municipalities in the catchment areas of both, "new uni" municipalities (treatment group 4) and always-treated "old uni" municipalities (treatment group 2). The

Figure C.8: Propensity to move with 19y-22y

New uni municipalities | 50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Controls: parental level of education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

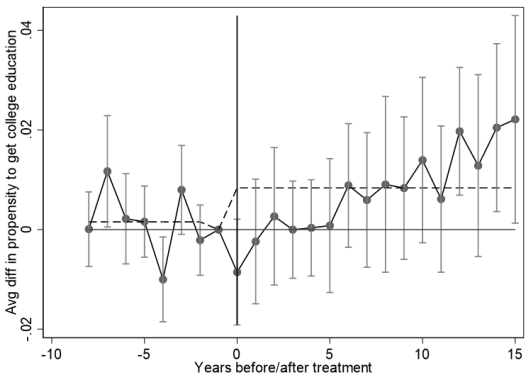
question is: how far does a university's (both old and new) effect on education and migration decisions reach in terms of geographical distance?

To make sure that my results do not depend on the choice of the size of the catchment areas, this section provides results for alternative definitions of 30km (Figure C.11 and Figure C.12) as well as 75km (Figure C.13 and Figure C.14). Comparing the estimates to the results of my main specification with a catchment area threshold of 50km, one can see that results for "new uni" municipalities do not change, even though the control group varies.

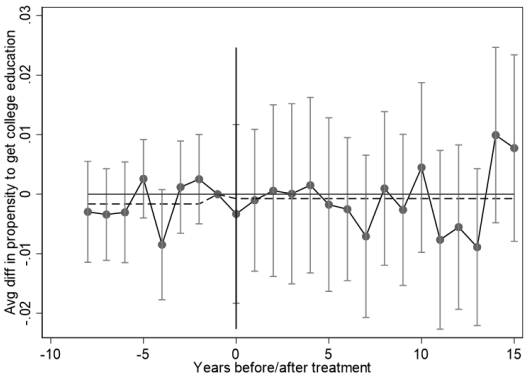
Looking at results for different catchment areas, where both treatment and control groups are different, there are little differences. The propensity to obtain a college degree is higher in the 30km specification (Figure C.11), indicating that there are some positive spill-overs in that area. As with 50km, the estimates are also zero with a 75km catchment area (Figure C.13). It seems that positive spatial spill-overs decay with distance and disappear somewhere between 30km and 50km, making municipalities beyond 50km a suitable control group. The propensity to move between 19-22 years shows a decay in the treatment effect, too. The average effect in the main specification with 50km is a little bit lower compared to the 30km specification (Figure C.12), but higher than estimates in the 75km variant (Figure C.14). For 75km, the estimated treatment effect is not significant even at the 10% level. I conclude that the SUTVA, the assumption requiring the control group to be unaffected by the treatment, is satisfied. However, even if we conclude that spatial spill-overs

Figure C.9: Propensity to obtain a college degree

New uni municipalities



50km catchment area of new uni

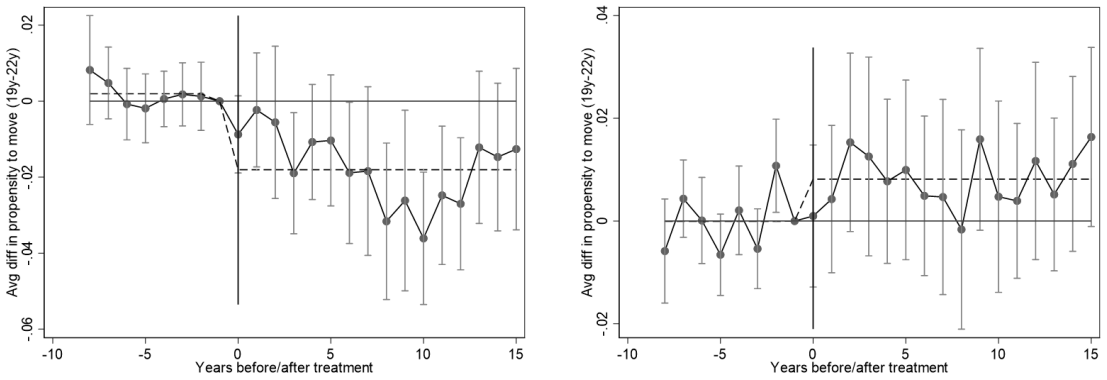


Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Municipalities that were close to an "old uni" municipality and got their own university are dropped as well. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

are not entirely zero for municipalities that are more than 50km away from the university, I argue that a 50km catchment area definition is sufficient. Using the 75km specification makes the control groups relatively small which results in the loss of precision and statistical power. In addition, estimates are, if biased at all, biased towards zero when a positive treatment effect is incorporated in the control group.

Figure C.10: Propensity to move with 19y-22y

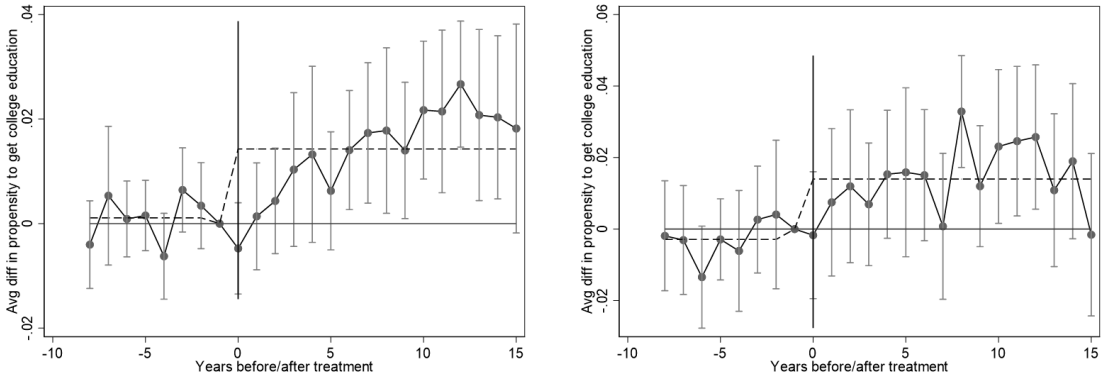
New uni municipalities 50km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 50km to below 50km (right). Always treated municipalities excluded. Municipalities that were close to an "old uni" municipality and got their own university are dropped as well. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

Figure C.11: Propensity to obtain a college degree; 30km

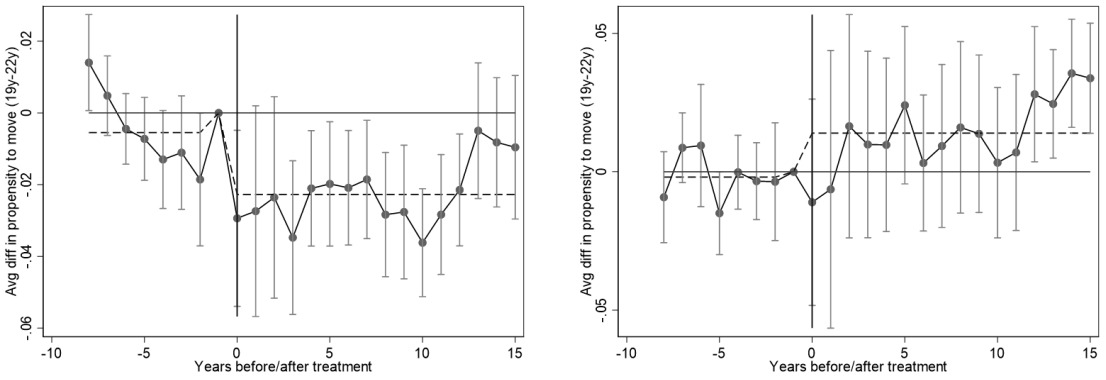
New uni municipalities 30km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 30km to below 30km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

Figure C.12: Propensity to move with 19y-22y; 30km

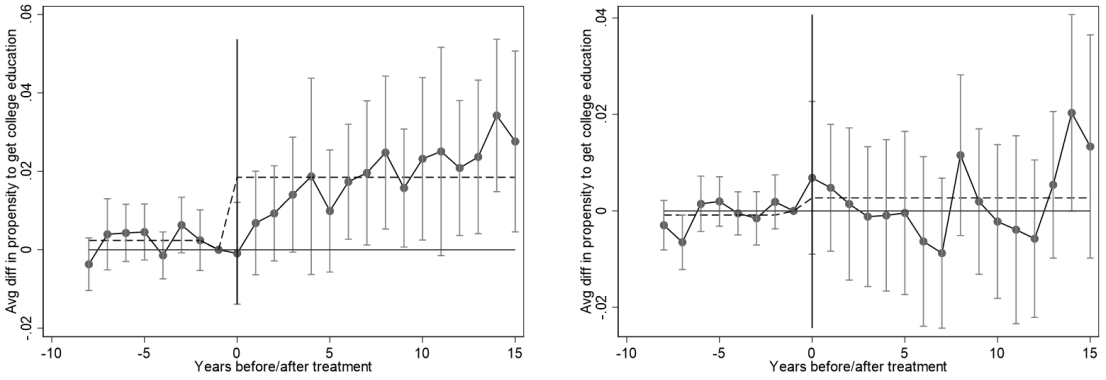
New uni municipalities | 30km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 30km to below 30km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

Figure C.13: Propensity to obtain a college degree; 75km

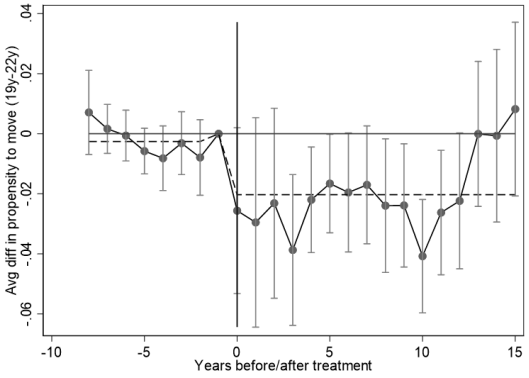
New uni municipalities | 75km catchment area of new uni



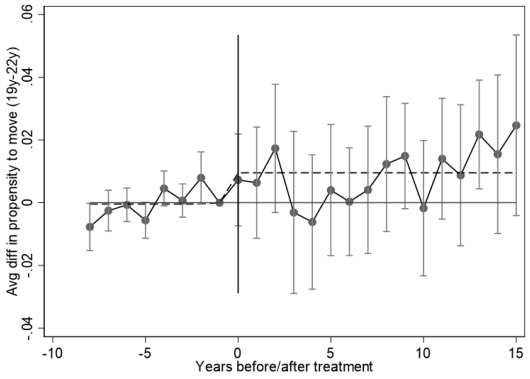
Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 75km to below 75km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.

Figure C.14: Propensity to move with 19y-22y; 75km

New uni municipalities



75km catchment area of new uni



Notes: Treatment status assignment by treatment status of the municipality of residence at age of 18 years. Treatment: new higher education institution (left) or drop in distance to closest higher education institution from above 75km to below 75km (right). Always treated municipalities excluded. Only including individuals with at least higher secondary education. Standard errors are clustered on the municipality level. 5% confidence intervals are displayed.