

Free Movement of Workers and Native Demand for Tertiary Education^a

Mirjam Bächli

Teodora Tsankova

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Abstract

We investigate how natives' demand for tertiary education responds to a reform that relaxed employment restrictions for foreign workers in Switzerland. The policy change led to a sharp increase in cross-border commuting into Swiss areas close to the border. We find that enrollment in universities with a focus on applied studies rises in affected commuting zones, and this increase is driven by natives with a vocational background. Enrollment rises mostly in non-STEM fields that foster skills less transferable across countries. We show that enrollment results are consistent with a rising wage premium for tertiary non-STEM degrees.

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^aMirjam Bächli is a Postdoctoral Researcher in Economics at the University of Lausanne (mirjam.baechli@unil.ch). Teodora Tsankova is an Assistant Professor of Economics at Tilburg University (t.n.tsankova@tilburguniversity.edu). We are grateful to Andreas Beerli, Michel Beine, Beatrix Eugster, James Fenske, Reto Föllmi, Albrecht Glitz, Clément Imbert, Michael Knaus, Rafael Lalive, Joan Llull, Sharun Mukand, Panu Poutvaara, David Schindler, Michael Siegenthaler, Stefan Wolter, Ulf Zölitz, Josef Zweimüller and two anonymous referees for comments and suggestions. We thank seminar participants at Tilburg University, University of St.Gallen, and University of Warwick for helpful comments. This paper uses confidential data from different Swiss authorities. The authors are willing to assist in obtaining the data. Each author declares that they have no relevant or material financial interests that relate to the research described in this paper. An Online Appendix is included.

1 Introduction

Higher education has gained momentum in the developed world with one in three people in the OECD holding a tertiary degree in 2020 (OECD, 2022). Schooling decisions have a significant impact on individual outcomes as there are substantial returns to acquiring higher education. For example, OECD graduates with a tertiary degree earned, on average, 55% more than those with an upper-secondary degree. Study decisions are likely tied to labor market opportunities, which depend on the relative skill distribution. International mobility can significantly alter the skill distribution in the host countries. Thus, if immigration reforms result in a substantial inflow of workers of a particular skill group, they can change incentives for natives to demand schooling.

In this paper, we focus on an inflow of skilled foreign workers who could either encourage or discourage natives to enroll into tertiary education depending on how labor market outcomes are affected. The traditional view is that skill groups most affected by an immigrant inflow face worse labor market conditions (Borjas, 1995; Borjas and Doran, 2012; Dustmann et al., 2012). This suggests that an inflow of skilled workers is likely to weaken native incentives to accumulate human capital. At the same time, there is evidence that skilled immigrants boost total factor productivity and innovation (Moser et al., 2014; Peri et al., 2015; Hunt, 2017), which suggests that incentives to invest in human capital may increase. This positive effect is likely to be particularly strong for skills that are complementary to the ones brought by foreign workers (Peri and Sparber, 2011; Ottaviano and Peri, 2012).

We explore how changes in labor market conditions induced by a free movement reform affect natives' educational decisions at the tertiary level. Switzerland offers a unique context to study this research question. Specifically, the Agreement on the Free Movement of Persons (AFMP) abolished restrictions to access the Swiss labor market for foreign workers from the European Union (EU) and European Free Trade Association (EFTA), including cross-border commuters. Commuters are employed in Switzerland but reside abroad, typically in neighboring countries. With the reform's introduction, the number of frontier workers

permanently increased. Moreover, the Swiss education system enables us to isolate education demand from supply forces as having completed upper-secondary education with a matura exam guarantees admission. Similar to other Western European countries, Switzerland’s dual education system gives access to tertiary education at universities (UNIs) to graduates with general training and at universities of applied sciences (UAS) to graduates with general and vocational training. Different educational backgrounds at the upper-secondary level are linked to a different level of labor market experience and are likely to lead to different enrollment decisions in response to changes in labor market conditions. Finally, we have access to administrative data on all individuals enrolled in tertiary education, which allows us to precisely quantify demand by institutional type and study field.

Our empirical strategy combines the timing of the AFMP implementation with cross-sectional variation in distance to the Swiss border in a difference-in-differences framework. Motivated by the fact that commuting costs rise with distance, we define Swiss areas close to the international border as affected commuting zones and those further away as non-affected ([Dustmann et al., 2017](#); [Beerli et al., 2021](#)). Indeed, approximately 90% of cross-border commuters are employed within 30 minutes of travel time from the border in 2016. We assign native students to their place of residence when they took their matura exam under the assumption that individuals consider local information at the time of enrollment. There is no evidence suggesting that trends in native educational and labor market outcomes would have been different in affected and non-affected commuting zones absent the reform.

We find that the share of commuters in affected commuting zones grew by 3.3 percentage points relative to the non-affected areas in the post-reform period. This effect corresponds to 22.9% relative to the average exposure in the pre-reform period, and it is driven by skilled commuters with an upper-secondary or tertiary education. We find that native first year enrollment at UAS rises in the post-reform period in affected commuting zones by 1.1 percentage points, which is 14.1% relative to the pre-reform average. UNI enrollment in affected relative to non-affected commuting zones does not change due to the reform.

We then map occupations to fields of study using survey data and classify the fields according to the extent to which they are affected by the exposure to commuters. Subjects are considered to be affected if they are linked to occupations that cross-border commuters hold relatively more often than resident workers. We find that enrollment in less affected fields of study at UAS rises in the post-reform period in commuting zones close to the border. These are mostly non-STEM fields that typically require more country-specific skills compared to STEM fields. Our findings are robust to different treatment definitions, outcome measures, and control variables.

The reform directly affected the workforce composition by raising the share of skilled foreign workers. We document a rise in the wages of natives with tertiary education and the likelihood that they hold a managerial position, while wages decrease for those with an upper-secondary degree. Furthermore, we investigate whether these effects differ by occupation. Wages for native tertiary-educated workers in affected areas increase for STEM and non-STEM workers, and the share of employed in management rises in particular for the latter group. Wages at the upper-secondary level increase for STEM workers and decrease for non-STEM workers. These results suggest complementarities between foreign workers, who are overrepresented in STEM professions, and high-skilled natives employed in non-STEM jobs.

We next look at the educational background of first-year tertiary students, which can be linked to their awareness of labor market conditions. We find that the rise in enrollment at UAS is driven by individuals with a vocational background at the upper-secondary level who are prepared to enter the labor market. This gives them knowledge of local labor market conditions, which is in contrast to individuals with a general background who are prepared to enter tertiary education only. More specifically, we show that the increase in enrollment comes from natives with a non-STEM background implying that natives respond by advancing their non-STEM skills, which is consistent with the rising labor market returns to non-STEM degrees that we estimate.

We contribute to the literature that links native educational outcomes to immigration, which has so far relied on evidence from the United States. Early work finds a negative effect of immigration on high school graduation rates of American-born minorities and argues that it is likely driven by competition for school resources (Betts, 1998). More recently, Hunt (2017) differentiates between adult immigrants and immigrants of school age. The results show that a higher share of low-skilled adult immigrants has a positive impact on high school completion through its effect on labor market conditions, while a higher share of school-aged immigrants has no effect. McHenry (2015) documents that low-skilled immigration has led to a rise in native educational outcomes at the secondary and post-secondary level. Lhull (2018) argues that the direction of response varies across the native population depending on individual labor market returns to education. Most of the existing work either assumes an exogenous immigrant allocation or uses a shift-share instrumental variable strategy, which relies on strong assumptions (for example, Goldsmith-Pinkham et al., 2020). In contrast, we focus on a policy experiment as an exogenous source of variation. The inflow of foreign workers we explore consists of cross-border commuters who do not compete with natives for school resources. This helps us to capture solely variation in local labor market conditions.

Our mapping between occupations and fields of study contributes to the literature on differences in occupational choices between immigrants and natives. Studies document that foreign-born workers are more often employed in scientific and technical occupations than natives (Peri and Sparber, 2009; Hunt and Gauthier-Loiselle, 2010; Peri and Sparber, 2011; Hanson and Slaughter, 2018). We confirm these findings in a context where the foreign workers are culturally and linguistically similar to the natives. Few studies link immigrant occupational choices to native enrollment in specific study fields. Ransom and Winters (2021) find that an increase in foreign STEM workers drives natives, specifically black male students, away from STEM fields of study in the United States. Cortés and Pan (2015) document a similar crowding-out effect from nursing studies. We add to this literature by considering all study fields, which increases generalizability. Grouping fields by the intensity

of expected labor market competition with foreign workers enables us to link enrollment decisions to labor market conditions at the field level.

The education literature shows that expected earnings and employment prospects matter in the study field choice (Befy et al., 2012; Long et al., 2015; Wiswall and Zafar, 2015; Schweri and Hartog, 2017; Acton, 2021; Abramitzky et al., forthcoming). A number of related studies exploit business cycles to evaluate the impact of opportunity costs on demand for education. There is evidence that enrollment is countercyclical at lower educational levels (Ayllón and Nollenberger, 2021), in college (Dellas and Sakellaris, 2003; Long, 2014), and in graduate school for women (Johnson, 2013). In comparison, we use an immigration reform that creates exogenous variation in local labor market conditions. We distinguish between individuals with general and vocational backgrounds to identify the groups of individuals most responsive to the changes in labor market conditions. This level of detail is novel to the literature and allows us to link responsiveness to reform changes with experience in the labor market.

To understand drivers of enrollment decisions, we investigate the labor market effects of a free movement of workers reform. There is mixed evidence on the impact of an inflow of foreigners on native labor market outcomes (Borjas, 2003; Ottaviano and Peri, 2012; Dustmann et al., 2016). Unlike most of the existing literature that looks at resident immigrants, we focus on cross-border commuters. In an early study, Dustmann et al. (2017) examine a temporary increase in low-skilled Czech frontier workers into Germany after the Berlin wall fell. The authors find a decline in wages and an even stronger drop in employment outcomes for natives. Looking at the same reform as we do, Beerli et al. (2021) find a positive effect on the wages of high-skilled natives and in addition document a positive impact on labor demand, productivity, and innovation. Cristelli and Lissoni (2020) show that natives who collaborate with cross-border inventors benefit from higher productivity. We extend this literature by examining the reform effects on native human capital accumulation, which likely have a long-run impact on the native skill composition. It is important to consider

such adjustments to understand the far-reaching effects of immigration on host country labor markets.

The remainder of the article is organized as follows. In Section 2 we discuss the regulatory framework applied to cross-border commuters and the educational system in Switzerland. In Section 3 we describe the data and outline the empirical strategy. In Section 4 we present our results on commuter exposure and enrollment outcomes and discuss the mechanisms in Section 5. In Section 6 we conclude.

2 Context

2.1 Cross-Border Commuting

Individuals with a citizenship from an EU or EFTA member state working in Switzerland are subject to the rules outlined in the Agreement on the Free Movement of Persons (AFMP), which was signed in June 1999, approved by the electorate in May 2000, and introduced on June 1, 2002.¹ The agreement affects all workers from EU and EFTA countries. We focus on cross border commuters who are non-Swiss by nationality and require a working permit to be employed in Switzerland. Because they need a working contract from a Swiss employer to receive or extend such a permit, frontier workers are employed individuals.

Before the AFMP, cross-border commuters and the firms that wanted to hire them had to fulfill several requirements. Commuters had to reside in formal border zones in the neighboring countries and were only allowed to work in similarly defined zones in the border area of Switzerland. Permits were tied to a specific employer and valid for up to one year, after which they had to be renewed. Commuters had to return to their place of residence daily. Furthermore, employers had to prove that the vacancy could not be filled by a native

¹The AFMP is a bilateral agreement. All restrictions that limited the free movement of Swiss nationals to EU and EFTA member states were completely removed in June 2002. The reform is expected to have benefited all natives regardless of their place of residence in Switzerland similarly. Specifically, it is unlikely to have promoted the commuting of Swiss nationals from border areas due to the relatively high living costs combined with high wage levels and low unemployment in Switzerland.

worker (local priority requirement).

The AFMP was implemented in three steps. From June 2002 onward, cross-border commuters from EU-15 and EFTA countries were free to reside outside the border zones of the home country. In addition, they were required to return to their place of residence only once a week rather than every day. The work permit was no longer bound to a specific job, and its validity was extended to the length of the working contract, for a maximum of five years. In June 2004 the local priority requirement was abolished, and as a result, cross-border commuters could be hired under the same conditions as resident workers in the Swiss border zones. Full liberalization across the entire country came into force in June 2007 when commuters were allowed to work anywhere in Switzerland. Interim regulations applied for other EU member states and were relaxed over time.

The number of cross-border commuters increased sharply after the free movement reform was implemented. As administrative data show, most of the commuters work in commuting zones in the border area, where their share in total employment rose from 9.9% in 2001 to 14.2% in 2017. In the latter year, 95% of all cross-border commuters were nationals of neighboring countries Austria, France, Germany, or Italy. Consistent with travel costs depending on distance, commuters generally work in commuting zones close to their place of residence where the same language is spoken.²

Table 1 shows how native workers differ from cross-border commuters. The average age of both types of workers is around 40 years, while women are underrepresented in the group of commuters. Native workers are less likely to have at most a lower-secondary education than commuters (11.1% versus 26.3%) and are more likely to have an upper-secondary education (64.3% versus 49.5%). The share of the tertiary educated is similar among the two types of workers. The likelihood of holding a position with managerial responsibilities is higher among native workers, while commuters are overrepresented among STEM workers. In Section 4

²Around 97% of Austrian and 98% of German commuters work in a Swiss municipality in which German is spoken by most residents. The share of Italian and French commuters who work in Italian- and French-speaking Swiss municipalities is 88% and 80%, respectively.

we explore how these shares evolve in affected and non-affected areas after the AFMP was implemented.

2.2 Dual Education System

The Swiss education system has features common to other European countries. At the upper-secondary level, one can follow two types of tracks: a vocational or specialized education track and a general education track (see Online Appendix Figure A1). According to the Swiss Federal Statistical Office (FSO), 66.6% of upper-secondary students pursue a vocational education in 2019, 6.8% a specialized education, and 26.6% a general education ([Bundesamt für Statistik, 2019a](#)). In the vocational track, an individual works three to four days a week as an apprentice and attends school the rest of the time. In the specialized track, an individual attends general and vocational school classes and does an internship. In the analysis, we refer to both tracks as vocational because they prepare students to enter the labor market or enroll in tertiary education. In contrast, the objective of the general track is to prepare students for enrollment in tertiary education only. To enter tertiary education, a student must pass a matura examination at the end of upper-secondary education. As of 2019, 22.1% of Swiss residents younger than 25 years hold a general matura, 15.9% a vocational matura, and 3.4% a specialized matura ([Bundesamt für Statistik, 2019b](#)). Sixty-four percent of the 2012 upper-secondary graduates with a vocational matura and 84% of those with a specialized matura enroll in tertiary education within 42 months after graduating. This is significantly lower compared to 94% of those with a general matura ([Bundesamt für Statistik, 2018](#)).

Two types of tertiary institutions exist: universities and federal institutes of technology (referred to as universities or UNIs) and universities of applied sciences (UAS). UNIs are the oldest institutions with a right to grant tertiary-level degrees, and the UAS were established in 1997.³ Unlike UNIs that are committed to a combination of teaching and research, UAS impart professional skills with a focus on practice and application. Roughly 60% of all

³UAS are organized by cantons. In some cantons the UAS include teacher education, while other cantons have set up independent teacher education universities. We combine these institutions with the UAS.

students are enrolled at UNIs in 2017 and 93.9% of them have a general background at the upper-secondary level. At UAS, 80.2% of all students have a vocational education. Both types of institutions offer STEM and non-STEM education. Around 58.1% of all UNI students are enrolled in a non-STEM field in 2017; this share is close to 63.3% at UAS.

The Swiss education system offers a unique setting to investigate enrollment decisions as the lack of supply constraints enables us to infer demand for tertiary education from enrollment. Besides a matura, no major entry restrictions exist for Swiss nationals at the undergraduate level. A general matura typically grants access to any degree in the chosen university. As an exception, health degrees can have a cap on the number of students enrolled in a year. UAS can require a certain major of the vocational matura or relevant work experience to enroll in specific fields, and they often conduct interviews to test the ability of candidates in social- or health-related fields. There is overall little screening at entry, but the pool of eligible students is already selected due to the admission requirements for upper-secondary education tracks resulting in a matura.

Figure 1 shows the locations of the tertiary education institutions across Switzerland in 2017. Most of the institutions are in the northern and western part of the country and are clustered in the urban centers. The 12 UNI institutions are spread over ten cities. In contrast, most of the UAS have several locations, which are often specific to a study field. The high density of institutions we observe in 2017 enables a large share of the population to commute daily to classes, lowering the costs of studying.⁴ UAS expanded considerably across the country during our study period. We will control for this change in the education supply in our analysis.

⁴Yearly study costs are estimated to be around CHF 24,000, including tuition fees that are generally below CHF 2,000 for Swiss nationals. See, for example, the calculations by the study advisory service from the [University of Zurich](#). On January 5, 2023, one Swiss franc (CHF) was equivalent to approximately USD 1.1.

3 Data and Methods

3.1 Data

In the enrollment analysis, we use administrative data from the Swiss Higher Education Information System (SHIS-studex). This is an individual-level database covering all matriculated students at UNIs and UAS in Switzerland. It includes students at UNIs since 1990 and UAS since their establishment in 1997. The variables used are age, gender, nationality, type of certificate granting access to tertiary education (matura), place of residence at the time of taking the matura (pre-enrollment place of residence), type of tertiary institution, and field of study. The structure of the SHIS-studex dataset allows us to track individuals from the point of enrollment up to graduation and provides information on received degrees. More information is available in the Online Appendix 3.

We are interested in demand for tertiary education and focus on first-year students enrolled in a bachelor’s program over the period 1997–2017. We do not include immigrant students in our baseline sample because their enrollment decisions may depend on different factors than the decisions of Swiss nationals (for example, [Schündeln, 2014](#)). We assign the native tertiary students to the commuting zone of residence at the time of receiving their matura. We calculate our main outcome as $Enrollment\ rate_{ct} = \frac{Nr\ first-year\ students_{ct}}{Birth\ cohort\ size_{ct}}$, where c is the commuting zone. The cohort is the Swiss population at the median age of first-year students, which is 21. To measure the cohort, we use information about the size of the native population at the municipality level and the age structure of the population at the cantonal level from the FSO. We add to the SHIS-studex dataset the geographic location of the tertiary institutions, which we collected from the institutions’ websites.

Additionally, we use information from the Survey of Higher Education Graduates (EHA), which is conducted every two years. The survey has a panel structure where individuals respond to questions related to their working experience and acquired skills one and five years after graduation. We use first-wave responses because we are interested in outcomes shortly

after graduation. We consider the subset of Swiss graduates with a bachelor’s or master’s degree who also have a Swiss matura. We then use information about the commuting zone of residence (current and at the time of taking the entrance exam), commuting zone of work, and the mapping between fields of study and occupations.

In the labor market analysis, we rely on the Swiss Earnings Structure Survey (SESS), which is a large-scale firm survey conducted every two years. It is a repeated cross-section of private sector firms in the secondary and tertiary sectors of the economy. Our sample covers the years 1996–2016. We use information on the firm location at the commuting zone level, which is the most detailed geographical unit available. We limit the sample in the main specification to employees aged 18–40 and in the robustness checks to employees aged 18–65. To calculate the share of cross-border commuters, we divide the number of commuters by the total number of employees. To calculate our labor market outcomes, we use data on native gross hourly wages, the level of managerial tasks, and the number of native employees. We differentiate three types of education based on the highest level attained — up to lower-secondary, upper-secondary, and tertiary training. We distinguish positions with medium or senior management responsibilities from positions with no management, and junior or executive management responsibilities. Similarly, we differentiate between workers in STEM and non-STEM occupations. When looking at occupations, we limit the observation period to 1996–2010 because different occupation classifications were used before and after 2010. We also use administrative data from the Cross-Border Commuters Statistics and publicly available employment data at the municipality level for 1995, both provided by the FSO.

Additionally, we collected travel time data for each municipality from www.map.search.ch, which we accessed in December 2018. We take the travel time by car from each municipality m to the closest border crossing or a border checkpoint according to the Federal Customs Office and calculate the measure $Travel\ time_c = \sum_{m \in c} Travel\ time_{m,2018} \times \frac{Nr\ employed_{m,1995}}{Nr\ employed_{c,1995}}$. Commuting zones with a border crossing or border checkpoint are assigned a value of zero minutes. The Federal Office of Topography (swisstopo) provides the com-

muting zone shapefile that we use.

3.2 Empirical Strategy

Motivated by the nature of the policy change, the empirical analysis is based on a standard difference-in-differences strategy. We investigate the reform effects by comparing commuting zones close to the border with those further away before and after the regulatory change. Figure 2 shows that exposure to commuters declines sharply with travel time from the border. In the main part of the analysis, we use a fixed threshold to define treatment, which is consistent with Beerli et al. (2021). Specifically, we consider commuting zones closer than a 30-minute commute as affected by the reform and those further away as not affected. This approach assigns 35 out of the 106 commuting zones to the affected group and the remaining 71 to the non-affected group (see Figure 1). There is no discontinuity in exposure to cross-border commuting at the 30-minute threshold. To take this into account, we consider different treatment assignments in alternative specifications. In one of these specifications, we use a continuous treatment definition based on distance to the border according to the formula $\exp(-0.05 \times \text{travel time})$. Figure 2 shows that the function follows closely how observed commuting flows vary with distance.⁵

We run the following specification in the main part of the analysis:

$$(1) \quad y_{ct} = \alpha + \beta_1 \text{Transition}_t \times 1(\text{Travel time}_c \leq 30 \text{ min}) + \beta_2 \text{Post}_t \times 1(\text{Travel time}_c \leq 30 \text{ min}) + \mathbf{X}'_{ct}\gamma + \delta_c + \delta_{nt} + \varepsilon_{ct},$$

where c is a commuting zone, n is a NUTS 2 region, and t is a year. In the enrollment analysis, c refers to the commuting zone of residence at the time of receiving the matura. In the labor market analysis, c refers to the commuting zone of the workplace.

⁵Figure 2 also reveals that commuters work further away from the border in 2017 than they did in 1997. The continuous function tracks well the relationship between commuter flows and travel time in both years and therefore accounts for the upward trend in the commuting distance. Criticism of difference-in-differences regressions with a continuous treatment has been recently raised by Callaway et al. (2021) as stronger assumptions tend to be required compared to the binary treatment case.

Our main outcome is the share of native first-year students in the birth cohort. We also look at the native gross hourly wage rate, the probability of holding a managerial position, and the number of those employed. To ensure that any differences in wages and the probability of holding a managerial position are not driven by compositional changes, we use residual values. These are obtained by regressing individual-level gross wages and an indicator for holding a middle or upper management position, respectively, on age, age squared, gender, and educational attainment controls. We then calculate the average value of the residuals within a commuting zone for each survey year (Edo, 2019; Peri and Yasenov, 2019).

We estimate the reform effect by distinguishing between three periods: pre-reform (1997–2001), transition (2002–2006), and post-reform (2007–2017). The observation period for the labor market outcomes is 1996–2016 due to data availability with the pre-reform period between 1996 and 2000 and the post-reform period between 2008 and 2016. The coefficients of interest, β_1 and β_2 , show the difference in the dependent variable between affected and non-affected commuting zones during and after the reform compared to pre-reform years.

We include commuting zone fixed effects to capture local variation in the outcomes of interest. The Swiss education system is organized at the cantonal level, with the catchment area of a tertiary institution typically extending over several cantons.⁶ Changes in an institution’s policy are therefore likely to affect geographic clusters of commuting zones in a similar way. To take this into account, we include NUTS 2 region \times year fixed effects δ_{nt} . In the baseline enrollment analysis, the vector of control variables \mathbf{X} includes the natural log of native population. Additional variables that could vary during the period and across commuting zones are introduced in robustness checks. Consistently, in the labor market analysis we also add commuting zone and NUTS 2 region \times year fixed effects. When estimating Equation 1, we use weights fixed in the first year of the analysis to account for the different

⁶Switzerland has seven NUTS 2 regions, and three commuting zones fall into more than one NUTS 2 region. We allocate the commuting zones to the NUTS 2 region in which the majority of the commuting zone’s population resides. The share of enrolled undergraduate students who come from the same NUTS 2 region as the one where the institution is located is, on average, 60.7% in 2017.

population and employment sizes across commuting zones. Standard errors are clustered at the commuting zone level.

Graphically we show yearly estimates β_t from the following event study:

$$(2) \quad y_{ct} = \alpha + \sum_{t=1997}^{2017} \beta_t Year_t \times 1(Travel\ time_c \leq 30\ min) + \mathbf{X}_{ct}'\gamma + \delta_c + \delta_{nt} + \varepsilon_{ct}.$$

The event study approach allows us to investigate the timing of the enrollment and labor market responses. The coefficients β_t capture the impact of the reform relative to the last year in the pre-reform period. This is 2001 in the enrollment analysis where we have yearly data. In the analyses on commuter exposure and labor market conditions with biennial data, the reference year is 2000.

The key assumption under which our results are valid is that enrollment rates and labor market conditions would have followed the same trend in affected and non-affected areas absent the reform. We compare yearly coefficients in the pre-reform period to investigate whether this assumption is likely to hold and find no evidence to the contrary. Pre-trends for overall and UNI enrollment are shown for 1991–2001 and for UAS enrollment, they cover the period since their establishment in 1997. Similarly, the results are robust to including additional control variables that could have evolved differently over time in the two groups of commuting zones. These results are discussed in more detail in Section 4.

The common trends assumption could be violated if other policy changes occurred during the study period and affected individuals residing in the affected and non-affected commuting zones differently. In the 2000s the Bologna reform was introduced, which promoted the international mobility of higher education students. The tertiary education systems in Switzerland and its neighboring countries were already similarly structured before the reform. This makes it unlikely that natives from commuting zones closer to the border more

often enroll into tertiary institutions in border areas abroad due to the Bologna reform.⁷ If anything, we expect that the reform increased enrollment into foreign institutions for natives coming from affected commuting zones, which would bias our estimates downwards.

The Stable Unit Treatment Value Assumption (SUTVA) is the second important identifying assumption. We are interested in local labor market conditions and their impact on demand for education and take the commuting zone as the unit of observation. A commuting zone has, on average, approximately 80,000 residents and 49,000 workers in year 2017. Commuting zones are considered small-scale labor markets and are constructed by the FSO as clusters of municipalities where a large share of the population resides and works. Specifically, the share of employed who reside in the commuting zone where they work, on average, 64.2%, and shares in the group of affected and non-affected commuting zones are virtually the same. Overall, the commuting zone reduces concerns about geographical spillovers because local labor market conditions are most relevant to individuals who reside in that region. Our approach is consistent with the literature showing that job search is local and the attractiveness of jobs declines sharply with distance ([Manning and Petrongolo, 2017](#)).

We argue that the labor market conditions in the pre-enrollment place of residence are major determinants of demand for education. This is consistent with [Long et al. \(2015\)](#), who show that local changes in earnings have a stronger impact on major choices in higher education than changes at the national level. [Acton \(2021\)](#) argues that changes in local employment conditions shape the labor market expectations of individuals enrolling into community college programs that are closely tied to specific occupations similar to UAS degrees. In our setting, own labor market experience as gained during the vocational education is likely local due to limited mobility at that age. As students tend to enroll into tertiary education shortly after graduating from upper-secondary education, the labor mar-

⁷The following are tertiary institutions located in the neighboring countries close to the Swiss border: the University of Konstanz and the Zeppelin University in Germany; universities of applied sciences in Dornbirn and Feldkirch in Austria; the University of Liechtenstein.

ket experience accrued during the vocational training is likely decisive. Another important information source for educational decisions is the experience of immediate family members (Xia, 2016), which is also arguably accrued locally.

The EHA survey allows us to investigate location choices after graduation relative to the pre-enrollment place of residence. In 2017, 59.0% of the graduates live in the same commuting zone where they resided during their upper-secondary education. Shares for the affected and non-affected areas are essentially the same. Almost 60% of all graduates report that finding a job in the local area is important or very important to them. The share of respondents who work in the same commuting zone where they resided before enrollment is 29.4%. The share is slightly higher in affected than in non-affected commuting zones, which does not point to an increased avoidance of foreign competition as a result of the reform. Because acquiring tertiary education is shown to increase geographical mobility (Malamud and Wozniak, 2012), these numbers should be conservative proxies for the ex-ante intention to return to the pre-enrollment place of residence. If, at the time of enrollment, individuals consider labor market outcomes other than those in the commuting zones where they reside, our estimates would tend towards zero by reducing the difference between those coming from affected and non-affected areas.

4 Results

In this section, we first investigate the reform effect on the inflow of cross-border commuters. Then we show our findings on native enrollment by institutional type and enrollment by field of study.

4.1 Exposure to Cross-Border Commuters

To justify the treatment assignment rule, we estimate Equation 1 and compare the share of cross-border commuters in total employment across affected and non-affected areas in the

different periods. Column 1 of Table 2 shows that commuting zones within 30 minutes of travel time from the national border experienced a large inflow of commuters relative to those further away after the AFMP was introduced. While average exposure in the affected commuting zones grew from 14.4% in the pre-reform period to 18.6% in the post-reform period, we estimate a reform effect of 3.3 percentage points after controlling for commuting zone fixed effects and NUTS 2 \times year fixed effects. Magnitudes increase during the post-reform period as shown in Figure 3a. The continuous rise in exposure to commuters highlights the permanent nature of the reform. Online Appendix Figure A2a replicates these results with administrative data; estimates are larger in magnitude as we fix the denominator in 1995 for which employment data are available. The results show that cross-border commuting was already slightly on the rise in the last years of the pre-reform period. This could be explained by an informal relaxation of regulations before 2002, which we take into account when discussing the timing of the enrollment results.

In Columns 2–4 of Table 2, and in Figures 3b–3d, we look at exposure to cross-border commuting by educational level. We find that the rise in the share of cross-border commuters among the upper-secondary educated is 4.6 percentage points. Among the tertiary educated, the rise is 3.2 percentage points in the post-reform period. The positive effect on the former group is already significant during the transition period. We do not find a significant increase in commuting of lower-secondary-educated workers as presented in the table, while the positive estimates in Figure 3b are driven by the choice of the reference year.

In Online Appendix Table A1 we test the sensitivity of the results to lower and higher threshold values in the treatment definition. We find that the estimated magnitude of the commuter inflow declines as we allocate commuting zones further from the border to the affected group. As a generalization, we confirm the rise in cross-border commuting using the continuous treatment measure. Another concern we address is whether resident immigrants are, like commuters, more often employed in commuting zones close to the border in the post-reform period. Online Appendix Figure A2b shows that the share of immigrants does

not evolve differently across affected and non-affected areas during the study period. We therefore focus on cross-border commuters as the relevant group of foreign workers given our empirical strategy.

Next, focusing on skilled individuals, we study whether cross-border commuters are over-represented among workers with certain types of skills. We start by linking fields to occupations and create the variable $Sh\ employed_j$, which proxies the share of employees trained in field j :

$$(3) \quad Sh\ employed_j = \sum_{o=1}^O Sh\ employed_o \times Sh\ employed_{oj}, \quad j \in [1, 22],$$

where $Sh\ employed_{oj}$ is the share of employed individuals in occupation o with a degree in field j , which we multiply by the share of employed in the same occupation $Sh\ employed_o$. Intuitively, we allocate individuals employed in an occupation to fields of study and take into account the occupation's size.

We infer the link between study fields and occupations from their joint distribution provided by the EHA survey (2003–2017). This approach is consistent with the fact that natives do not observe the education of commuters but have knowledge of their occupations. We add the distribution of cross-border commuters and residents across occupations from 1999 and 2000 administrative data, respectively. These years are the earliest available and hence alleviate concerns about endogenous adjustments in the native occupational choices to changes in the skill levels of commuters or vice versa. Finally, we divide the skill supply of cross-border commuters by the skill supply of resident workers in a field:

$$(4) \quad Relative\ skill\ supply_j = \frac{Sh\ cross-border\ commuters_j}{Sh\ residents\ employed_j}, \quad j \in [1, 22].$$

The $Relative\ skill\ supply_j$ measure shows how the high-skilled commuters are allocated across

study fields j relative to the high-skilled workers residing in the country. A higher value of the measure implies that commuters are relatively more likely to have received training in this specific field than resident workers.

In Column 2 of Table 3, we present the skill supply of commuters relative to that of resident workers for each study field. The least affected fields – those with the lowest ratio – are listed first, and the most affected fields come last. Frontier workers are more often trained in architecture and construction, ICT, and forestry, which are study fields that build technical and numerical skills. Commuters are underrepresented in education, languages, and law, which are fields that build knowledge less transferable across borders and require social skills or a high level of language skills. If we divide the study fields based on the variable *Relative skill supply* into affected (value above one) and non-affected (below one), we see that the former group coincides with STEM and the latter with non-STEM fields. There are two exceptions: the arts is a non-STEM subject classified as affected, and health is a STEM field classified as non-affected.

In Table 4, we study the variation in the commuters’ skills over time and complement the static picture of the skill distribution presented in Table 3. Specifically, we investigate the change in exposure to cross-border commuters by both education and occupation. We consider upper-secondary and tertiary levels of education, and we split occupations into STEM and non-STEM. At both levels we observe a stronger inflow in STEM than in non-STEM occupations in the transition and post-reform periods. The literature has established a similar specialization pattern between native and immigrant workers (Hunt and Gauthier-Loiselle, 2010; Hanson and Slaughter, 2018). We confirm this finding in a context where foreign workers are culturally and linguistically similar to the natives, as discussed in Section 2.

To summarize, our findings on the effect of the AFMP on cross-border commuting are consistent with Beerli et al. (2021). In addition, they show evidence that the reform had a positive effect on labor demand in affected areas because additional jobs were created for the

new foreign workers. Productivity and innovation rise mainly at firms that were previously unable to recruit skilled workers. The greater availability of cross-border workers also encouraged capital formation as proxied by firm entry. These changes come from skill-intensive sectors such as high-tech manufacturing and knowledge-intensive business services. As these industries employ skilled individuals, changes on the demand side can affect labor market conditions relevant to natives who are about to decide whether to enroll in tertiary education or not. Ultimately, both supply and demand shifts likely affect how native conditions respond to the policy change. Our estimates are thus interpreted as reform effects.

4.2 Enrollment by Institutional Type

Summary statistics in Table 5 show that during our study period, average enrollment in tertiary education is higher in commuting zones affected by the reform’s introduction than in those not affected. This difference comes from enrollment at UNIs. Enrollment rates are, on average, similar at UAS in the two groups of commuting zones, but Online Appendix Figure A3 shows that enrollment grew faster in affected commuting zones after the reform was implemented. We next test whether these patterns are statistically significant and persist conditional on fixed effects and control variables.

The estimates in Column 1 of Table 6 show a positive but insignificant rise in overall enrollment in the post-reform period among individuals residing in affected commuting zones before beginning their studies compared to non-affected commuting zones. The responses differ by institutional type. Results in Column 3 indicate that individuals from affected areas enroll significantly more often at UAS. The magnitude of the effect is 1.1 percentage points. Average enrollment rates in the affected areas increase from 7.8% in the pre-reform period to 18.4% in the post-reform period. The reform effect can account for almost 10.4% of the enrollment growth observed during the period and is 14.1% of the pre-reform enrollment level. In contrast, in Column 2 we find no change in entry into UNIs between the affected and non-affected areas.

Figure 4 shows that demand for tertiary education, overall and by institutional type, evolves similarly between the affected and non-affected commuting zones in the pre-reform years. This suggests that the common trends assumption is likely to hold. Indeed, the timing of the increase in enrollment at UAS is in line with the intensity of the inflow of cross-border commuters presented in Figure 3a. Although we observe a small increase in commuting in the pre-reform period, we find that enrollment goes up only in the post-reform period, when all barriers were abolished, and the inflow of frontier workers was significant.

Panels A and B of Online Appendix Table A2 show that the threshold of 30 travel minutes is not decisive for the main findings. Moreover, the estimates remain similar when using the continuous travel time measure (Panel C). Online Appendix Table A3 investigates whether the rise in UAS enrollment is sensitive to different control variables and the weighting scheme. Changes in the supply of education and demand for labor could be confounding factors to the common trend assumption. We test whether the rise in enrollment rates is driven by the availability of new study locations and study fields because our observation period coincides with the expansion of UAS.⁸ Column 2 shows that the result is robust to controlling for the presence of UAS as well as the number of study fields offered at UAS within a radius of 20 kilometers.⁹ Note that the reform estimate is of similar size to the effect of a change from no to at least one UAS institution within this radius. There may be concerns that labor demand evolved differently between affected and non-affected commuting zones due to factors such as export demand (Atkin, 2016). We therefore include a Bartik-type measure of employment, relying on the industrial composition of each commuting zone in 1995, and aggregate annual employment growth at the industry level (see Bartik, 1991).¹⁰

⁸Hoxby (2009) finds, for the United States, that university choice is less driven by distance in recent times partly due to declining transportation costs. In the context of Switzerland, Denzler and Wolter (2010) argue that the distance to university matters for both the decision to enroll and the study field choice, particularly for individuals from middle and low socio-economic groups.

⁹We calculate the 20 kilometers as the distance from the largest municipality in a commuting zone in 1990.

¹⁰We construct the Bartik variable as follows: $Bartik_{ct} = \sum_i Sh_{employed_{ic1995}} \times \frac{Nr_{Employed_{it}}}{Nr_{Employed_{i1995}}}$, where i denotes the industry, c denotes the commuting zone, and t denotes the year. The industry definition follows the General Classification of Economic Activities (NOGA-08) at the two-digit level.

As reported in Column 3, controlling for labor demand does not change the results compared to our baseline specification. Additionally, in Columns 4 and 5 we confirm that the control variables, the NUTS 2 region \times year fixed effects, and the weights do not drive the results.

In Online Appendix Table A4 we redefine our outcome variable. We investigate the reform effect on the natural log of the number of natives enrolled and confirm that the effect is not driven by the variation in the cohort’s size over time in Column 2. In Column 3 we look at the enrollment rate of native and immigrant students and show that results are consistent with our baseline measure. In the last column, we test if there is an impact on the graduation rates of the first-year students. We compute the graduation rate of students as $Graduation\ rate_{ct} = \frac{Nr\ graduates\ by\ 2017_{ct}}{Nr\ first-year\ students_{ct}}$, where t is the first year of enrollment. We focus on first-year students who enrolled in the period 1997–2013, which leaves them with at least four years to complete a three-year bachelor’s degree. We find no evidence for significant differences in graduation rates between affected and non-affected areas among those who enrolled shortly after the AFMP was implemented.

We conduct a heterogeneity analysis to investigate selection. We examine if natives respond differently by pre-determined variables such as age, gender, and characteristics of their pre-enrollment place of residence. The results in Online Appendix Table A5 for UAS show that the rise in enrollment in the post-reform period is driven by individuals who are of relatively young age (21 and younger). This finding is in line with Wiswall and Zafar (2015), who show that younger students are more responsive to changes in future earnings than older students. The opportunity cost of studying in terms of forgone wages is arguably lower for the younger group. The estimates are statistically significant for male and not for female enrollment, but the difference between the two coefficients is not significant. The same holds for those coming from urban and rural commuting zones, and from different language regions.

4.3 Enrollment by Field of Study

Cross-border commuters are more likely employed in STEM occupations than natives as shown in Tables 3 and 4. Online Appendix Figures A3d and A3e plot raw enrollment rates into STEM and non-STEM fields at UAS and show that demand for non-STEM fields grew faster in affected relative to non-affected commuting zones in the post-reform period. We next test whether these changes are statistically significant using the difference-in-differences specification.

The estimates in Panel C of Table 7 and Figure 5 confirm the rise in enrollment in non-STEM fields. We estimate a 0.8 percentage points increase in the post-reform period that can account for 9.8% of the increase in enrollment observed during the period and is almost 21% of the pre-reform average. The evidence from the analysis of enrollment in non-affected fields is consistent. Ransom and Winters (2021) estimate that natives are crowded out of STEM fields in regions with more foreign workers, but we find no such evidence. When we split the group of non-STEM fields into separate ones following the International Standard Classification of Education (ISCED) classification, we find that the positive post-reform effect at UAS comes from welfare, business, and arts (see Online Appendix Table A6). We argue that the skills especially acquired from a business study could be complementary to the STEM skills brought by the commuters. Panels A and B of Table 7 show no evidence of a change in enrollment by field of study overall and at UNIs, respectively.

In Online Appendix Table A7 we show that the overall increase in the demand for non-STEM and non-affected fields is robust to variations in the threshold that defines the affected area. Enrollment in STEM and affected fields turn significant at lower and higher thresholds than 30 minutes and in the continuous specification. Overall, the rise in non-STEM enrollment is robust and of larger magnitude compared to the STEM enrollment results that depend on the treatment definition. Online Appendix Table A8 reports results from specifications including additional control variables in Columns 2–3, without control variables and NUTS 2 region \times year fixed effects in Column 4, and without weighting scheme in Column

5. The estimates remain very close to the ones from the main specification. In an unreported analysis we confirm that the results are also robust to alternative definitions of the outcome variable analogous to Online Appendix Table A3 for UAS enrollment.

5 Mechanisms

Natives respond to the free movement reform by acquiring more tertiary education at UAS. When faced with stronger foreign competition in the labor market, education offers an opportunity to stay competitive and to benefit from complementarities by specializing in fields that foreign workers are less likely to be trained in. In this section, we explore mechanisms related to labor market outcomes by building on the work of Beerli et al. (2021). We examine native wages, the probability of holding a managerial position, and employment by education level and occupation and discuss the timing of these effects relative to the timing of the enrollment responses. We distinguish first-year students by their educational background at the upper-secondary level to test whether previous labor market experience affects how responsive enrollment decisions are to changing labor market conditions. Below, we present evidence that enrollment decisions are consistent with changes in native labor market outcomes. Then, we consider an alternative mechanism that relates to the enrollment of foreign students, but we do not find evidence that it plays a role in our setting.

5.1 Native Labor Market Conditions

The inflow of commuters into local labor markets is likely to affect natives' labor market conditions. We focus on young native workers as changes in their labor market conditions are likely most relevant for the educational decisions of upper-secondary graduates. Panel A of Table 8 reports a decrease in wages for upper-secondary-educated workers that is driven by the late post-reform period between 2012 and 2016. In contrast, we find evidence of an increase in wages for tertiary-educated workers, which is largest in the early post-reform

period between 2008 and 2010.¹¹ To better understand responses at the study field level, we examine native wages by education and occupation. Columns 1 and 2 in Panel A of Table 9 show that at the upper-secondary level in the post-reform period the returns tend to rise in STEM occupations and fall in non-STEM occupations. The positive estimate for workers with a tertiary education is driven by non-STEM occupations, though the results are insignificant with a p -value of 0.11. This evidence is consistent with the rising demand for non-STEM tertiary education and with the literature showing that future earnings matter for major choice (Schweri and Hartog, 2017; Abramitzky et al., forthcoming).

Wage effects could be hard to observe, especially for young individuals. In addition, the study field choice elasticity has been found to be often relatively low (Patnaik et al., 2021). Changes in the type of positions that natives hold are important indicators for career prospects and may be more visible. In Panel B of Table 8 we look at the probability that natives hold at least middle management positions and find that the share of tertiary-educated natives holding such positions tends to increase starting in the transition period in affected commuting zones, but these results are statistically significant only in the full sample of workers (see Table A9). We find that the increase is driven by those employed in non-STEM occupations (Panel B of Table 9). This pattern is consistent with the changes in wages for tertiary-educated workers.

Changes in the number of natives employed with certain types of skills can be another visible signal of improving or worsening labor market conditions. Our results in Panel C of Tables 8 and 9 show that the number of native workers by education, and by education and occupation, do not evolve differently during the observation period in affected and non-affected areas.¹² Consistently, Online Appendix Figure A4 shows no differential trend in native population size between affected and non-affected areas. Therefore, native reloca-

¹¹Note that the estimates based on all employees are provided in the Online Appendix (see Tables A9 and A10) and are consistent with the results based on the subset of young workers.

¹²In an unreported analysis we also look at the native employment and unemployment rates by education based on data from the [Swiss Labor Force Survey](#) from the FSO. We do not find that these outcomes evolved differently between affected and non-affected areas during our observation period.

tion away from the border areas due to the reform should not pose an issue to the effect identification ([Borjas, 2006](#)).

We observe a higher demand for tertiary education at UAS. In 2017, around 80% of first-year students at these institutions have a vocational background. We show in [Table 10](#) that the rise in enrollment at UAS is driven by students with a vocational background.¹³ The response of the vocationally educated can be explained by their higher awareness of changes in local labor market conditions compared to the generally educated. Labor market conditions of upper-secondary-educated workers are directly relevant to natives with a vocational background because of their outside options. Moreover, a vocational training likely increases the level of knowledge about returns to tertiary education due to its focus on practical experience in contrast to general education. We also investigate the type of study field at the upper-secondary level and find in [Column 4 of Table 10](#) that individuals with a non-STEM background react to the reform. We conclude that access to tertiary education enables natives to upgrade their non-STEM skills and benefit from the rising wage premium for non-STEM tertiary degrees.

To summarize, our labor market analysis suggests that the increase in non-STEM enrollment at UAS can be attributed to lower opportunity costs of studying, higher returns to a tertiary degree, or to a combination of the two factors. The decrease in wages for upper-secondary educated workers coincides with the period when native enrollment increased the most. The increase in wages for tertiary educated workers started before the rise in native enrollment and persisted after the reform was fully implemented. Overall, timing suggests that the rise in native demand for tertiary education is a response to recent shocks in the labor market. Thus, higher education enables natives to take advantage of complementarities between native and foreign workers.

¹³This link to the professional world persists during the studies: students at UAS report more often that they work while studying (79%) compared to those at UNIs (69%) ([Bundesamt für Statistik, 2020](#)).

5.2 Foreign Student Enrollment

We next test an alternative mechanism that relates to the role of foreign student enrollment. The literature on university enrollment and study field choice has investigated the link between the presence of foreign students and natives' decisions. Recent studies find, on average, no or a positive effect on native enrollment ([Machin and Murphy, 2017](#); [Shih, 2017](#)). Earlier studies also document crowding-out effects ([Borjas, 2004](#)). At the field level, there is some evidence that foreign students reduce the likelihood that natives major in a STEM field ([Orrenius and Zavodny, 2015](#); [Anelli et al., forthcoming](#)). Unlike in the US and the UK, where these studies were conducted, Switzerland has generally no cap on the maximum number of students enrolled that could explain crowding out. Moreover, tuition is, to a large degree, publicly funded, which makes it unlikely that there is cross-subsidization of native students through tuition fees paid by foreign students. We conclude that the mechanisms discussed in these studies are not directly applicable in the Swiss context.

Our empirical strategy further mitigates concerns that natives' educational decisions are affected by foreign students. We measure the overall demand for two types of institutions and for broad groups of study fields. This alleviates the potential crowding-out or crowding-in effect at the institution \times narrow field level as switching between individual institutions and related fields can help students to avoid or to find more foreign peers. At the same time, the share of foreign students in all students enrolled at the bachelor level is sizeable in Switzerland (close to 19% in 2017). In the rest of this subsection, we consider the role of immigrant students — non-Swiss with a Swiss entry exam — and international students — non-Swiss without a Swiss entry exam to tertiary education.

Immigrant students have contact with natives in their pre-enrollment place of residence and also within the educational system before enrolling into tertiary education. They represent about 7% of total enrollment in 2017, and this number is similar at UNIs and UAS and in STEM and non-STEM fields. If their enrollment evolved differently in affected and non-affected areas during the study period, this could have an effect on native demand for

education. We first test if the reform had a direct effect on immigrant student enrollment. In Online Appendix Table [A11](#) we look at enrollment among first-year immigrant students and observe a drop during the transition period driven by UNIs. This result should be taken with caution given that the negative trend started during the pre-reform period. Moreover, immigrants are a relatively small group of individuals who migrate for a variety of reasons and are likely to selectively move into areas of the country. Given these results, we do not expect that the reform affects native enrollment through a change in the student composition at UAS. Second, we test whether our main result is robust to controlling for changes in immigrant enrollment by institutional type or field. by changing immigrant enrollment by institutional type or field. The estimates in the last column of Online Appendix Tables [A3](#) and [A8](#) show that higher immigrant enrollment at UAS and in non-STEM at UAS, respectively, is correlated with higher native demand for education, but our coefficient of interest remains very close to the baseline specification.

The share of international students in total enrollment was approximately 12% in 2017. In contrast to immigrant students, international students arrive in Switzerland at the time when they enter tertiary education. They reside abroad when taking their entry exam to tertiary education, so it is not possible to allocate them to a commuting zone of residence and replicate the analyses performed with immigrant students. As natives are not exposed to international students in lower education levels, it is unlikely that they are a factor in their enrollment decisions. Most importantly, for international students to present a challenge to our empirical strategy, they must impact natives coming from the affected and non-affected areas differently. In addition, this impact needs to vary over time in line with the timing of the free movement reform. As the share of international students at UAS stayed around 9% between the early 2000s and 2017, we consider it unlikely that their presence plays a role in explaining our results.

6 Conclusion

We examine the impact of the introduction of free movement of workers on native demand for tertiary education in Switzerland. Our findings reveal that individuals from commuting zones with high exposure to cross-border commuters enroll more often at universities with a focus on applied studies and select study fields mostly linked to non-STEM occupations. These are occupations in which frontier workers are underrepresented and complementarities between native and foreign workers could arise. Our results are driven by individuals with a vocational background at the upper-secondary level who have viable labor market options. We show that their enrollment decisions are consistent with a rising wage premium for tertiary non-STEM degrees.

The education system in Switzerland, similar to other European countries, grants access to tertiary education to individuals with a general and a vocational background at the upper-secondary level. At the tertiary level, they usually enroll at different institutions with a focus on general or specific skills, respectively. This institutional feature contributes to a labor force with a diverse skill set. As we have shown, access to education for people with different backgrounds provides an important margin to respond to changes in labor market conditions. The opportunity to upgrade skills can facilitate the transitions between work and education as a response to labor market shocks.

Immigrants often bring distinct skills to the labor market that complement native workers. A sudden outflow of foreigners due to a more restrictive migration policy or deteriorating relative economic conditions in the host country could result in a shortage of skills that foreign workers were previously supplying. This problem is exacerbated by a further specialization among the native population due to changes in education demand as shown in this study. As skill acquisition is typically a long-term process, these findings should be taken into account when considering changes to immigration policies.

Tables

Table 1: Characteristics of Native versus Cross-Border Workers

	Native workers		Cross-border commuters	
	Mean	Sd	Mean	Sd
Age	40.508	1.278	40.258	1.899
Share women	0.374	0.055	0.295	0.086
Share with lower-secondary education	0.111	0.045	0.263	0.196
Share with upper-secondary education	0.643	0.071	0.495	0.145
Share with academic tertiary education	0.129	0.066	0.148	0.081
Share with professional tertiary education	0.116	0.028	0.094	0.050
Share in no managerial position	0.614	0.053	0.714	0.074
Share in junior or executive managerial position	0.217	0.038	0.203	0.053
Share in medium or senior managerial position	0.169	0.029	0.083	0.037
Share in STEM occupation	0.428	0.109	0.614	0.128
Share in non-STEM occupation	0.572	0.109	0.386	0.128

Source: SESS.

Note: The observation period is 1996–2016. Data is at the commuting zone level. Lower-secondary level of education is compulsory education as highest degree; upper-secondary is a degree from an upper-secondary education with or without a matura exam; academic tertiary is a degree from a university or university of applied sciences; and professional tertiary is a degree from other types of higher education institutions. Observations are weighed by the number of native workers or cross-border commuters, respectively.

Table 2: Exposure to Cross-Border Commuters by Educational Level

	Outcome: share of cross-border commuters			
	All	Up to lower-secondary	Upper-secondary	Tertiary
	(1)	(2)	(3)	(4)
30min * 2002-2006	0.013** (0.006)	-0.002 (0.007)	0.021** (0.008)	0.005 (0.007)
30min * 2008-2016	0.033*** (0.012)	0.014 (0.009)	0.046*** (0.016)	0.032*** (0.011)
Mean outcome	0.072	0.070	0.069	0.069
Sd outcome	0.109	0.129	0.103	0.098
Commuting zones	106	106	106	106
within 30 min	35	35	35	35
N	1166	1166	1166	1160

Source: SESS.

Note: The table shows difference-in-differences estimates using biennial data at the commuting zone level for the period 1996–2016. The dependent variable is the share of cross-border commuters in total employment by educational level. Observations are weighed by the number of total employees in 1996. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3: Cross-Border Commuters Relative to Resident Workers by Study Field

Field of study	STEM field	Skill supply of commuters relative to residents
	(1)	(2)
Education	0	0.495
Languages	0	0.596
Law	0	0.653
Welfare	0	0.663
Journalism and information	0	0.670
Personal services	0	0.719
Humanities (except languages)	0	0.728
Social and behavioral sciences	0	0.764
Health	1	0.800
Veterinary	0	0.819
Business and administration	0	0.883
Arts	0	1.179
Mathematics and statistics	1	1.318
Biological and related sciences	1	1.384
Agriculture	1	1.547
Manufacturing and processing	1	1.549
Environment	1	1.613
Physical sciences	1	1.652
Engineering and engineering trades	1	1.948
Forestry	1	1.968
Information and communication technologies (ICT)	1	2.304
Architecture and construction	1	2.470

Sources: EHA, FSO.

Note: Column 1 distinguishes between STEM and non-STEM two-digit ISCED study fields. Column 2 shows the ratio of the share of commuters trained in a study field relative to the share of residents trained in the same field according to Equation 4.

Table 4: Exposure to Cross-Border Commuters by Education and Occupation

	Outcome: share of cross-border commuters			
	Upper-secondary		Tertiary	
	STEM (1)	Non-STEM (2)	STEM (3)	Non-STEM (4)
30min * 2002-2006	0.024*** (0.009)	0.008 (0.006)	0.023 (0.014)	0.004 (0.007)
30min * 2008-2010	0.033** (0.015)	0.019* (0.011)	0.044** (0.020)	0.026** (0.010)
Mean outcome	0.081	0.039	0.096	0.050
Sd outcome	0.125	0.063	0.129	0.069
Commuting zones	106	106	106	106
within 30 min	35	35	35	35
N	848	848	824	837

Source: SESS.

Note: The table shows difference-in-differences estimates using biennial data at the commuting zone level for the period 1996–2010. The dependent variable is the share of cross-border commuters in total employment by educational level and occupation. Observations are weighed by the number of total employees in 1996. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 5: Summary Statistics

	Affected areas			Non-affected areas		
	N	Mean	Sd	N	Mean	Sd
Enrollment rate	735	0.354	0.094	1491	0.311	0.083
... at universities	735	0.206	0.082	1491	0.170	0.060
... at universities of applied sciences	735	0.148	0.053	1491	0.141	0.049
... in agriculture	735	0.003	0.002	1491	0.004	0.003
... in arts and humanities	735	0.039	0.017	1491	0.031	0.014
... in business and law	735	0.092	0.028	1491	0.081	0.026
... in engineering	735	0.050	0.015	1491	0.048	0.014
... in health and welfare	735	0.046	0.028	1491	0.035	0.022
... in ICT	735	0.011	0.006	1491	0.011	0.006
... in math and sciences	735	0.033	0.012	1491	0.029	0.011
... in services	735	0.004	0.005	1491	0.003	0.004
... in social sciences	735	0.038	0.020	1491	0.031	0.015
Mean ln gross hourly wage	385	3.573	0.098	781	3.564	0.109
... of lower-secondary educated	385	3.298	0.082	781	3.297	0.083
... of upper-secondary educated	385	3.519	0.081	781	3.496	0.081
... of tertiary educated	385	3.934	0.088	774	3.937	0.085
Share employed in management	385	0.144	0.031	781	0.141	0.029
... with lower-secondary education	385	0.027	0.023	780	0.025	0.023
... with upper-secondary education	385	0.107	0.026	781	0.102	0.025
... with tertiary education	385	0.439	0.093	774	0.439	0.097
ln number employed	385	10.094	0.908	781	10.347	1.188
... with lower-secondary education	385	7.961	0.859	781	7.971	0.976
... with upper-secondary education	385	9.607	0.861	781	9.888	1.132
... with tertiary education	385	8.333	1.198	774	8.724	1.567

Sources: SESS, SHIS-studex.

Note: The table shows summary statistics for native outcome variables. The observation period for the enrollment outcomes is 1997–2017 and for the labor market outcomes 1996–2016. Data is at the commuting zone level. Lower-secondary level of education is compulsory education as highest degree; upper-secondary is a degree from an upper-secondary education with or without a matura exam; tertiary is a degree from a university or university of applied sciences. Native enrollment rate is the share of native first-year students in the birth cohort. One-digit ISCED fields of studies are considered. Observations are weighed by the native cohort size in 1997 and the number of native employees in 1996 by education group, respectively.

Table 6: Native Enrollment Rate by Institutional Type

	Outcome: share of native first-year students in birth cohort		
	All	University	University of applied sciences
	(1)	(2)	(3)
30min * 2002-2006	-0.000 (0.007)	-0.003 (0.004)	0.003 (0.004)
30min * 2007-2017	0.010 (0.007)	-0.001 (0.006)	0.011** (0.004)
Mean outcome	0.326	0.183	0.143
Sd outcome	0.089	0.071	0.050
Commuting zones	106	106	106
within 30 min	35	35	35
N	2226	2226	2226

Source: SHIS-studex.

Note: The table shows difference-in-differences estimates using annual data at the commuting zone level for the period 1997–2017. The dependent variable is the share of native first-year students in the birth cohort by institutional type. Observations are weighed by the cohort size in 1997. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 7: Native Enrollment Rate by Type of Study Field

	Outcome: share of native first-year students in birth cohort			
	STEM (1)	Non-STEM (2)	Affected (3)	Non-affected (4)
<i>Panel A: All institutions</i>				
30min * 2002-2006	0.000 (0.004)	-0.001 (0.005)	-0.001 (0.003)	-0.000 (0.005)
30min * 2007-2017	0.002 (0.003)	0.005 (0.005)	0.001 (0.003)	0.007 (0.005)
Mean outcome	0.119	0.206	0.103	0.222
Sd outcome	0.035	0.061	0.025	0.071
Commuting zones	106	106	106	106
within 30 min	35	35	35	35
N	2226	2226	2226	2226
<i>Panel B: Universities</i>				
30min * 2002-2006	-0.001 (0.002)	-0.003 (0.003)	-0.001 (0.002)	-0.002 (0.003)
30min * 2007-2017	-0.000 (0.002)	-0.003 (0.004)	-0.002 (0.002)	-0.001 (0.004)
Mean outcome	0.066	0.116	0.051	0.131
Sd outcome	0.026	0.049	0.019	0.057
Commuting zones	106	106	106	106
within 30 min	35	35	35	35
N	2226	2226	2226	2226
<i>Panel C: Universities of applied sciences</i>				
30min * 2002-2006	0.001 (0.003)	0.001 (0.003)	0.001 (0.002)	0.002 (0.004)
30min * 2007-2017	0.003 (0.003)	0.008*** (0.003)	0.003 (0.002)	0.008** (0.003)
Mean outcome	0.053	0.091	0.052	0.091
Sd outcome	0.020	0.039	0.014	0.043
Commuting zones	106	106	106	106
within 30 min	35	35	35	35
N	2226	2226	2226	2226

Source: SHIS-studex.

Note: The table shows difference-in-differences estimates using annual data at the commuting zone level for the period 1997–2017. Affected fields are those with a relative skill supply measure above one as shown in Table 3. The dependent variable is the share of native first-year students in the birth cohort by study field and institutional type. Observations are weighed by the cohort size in 1997. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 8: Native Labor Market Outcomes by Educational Level

	All (1)	Up to lower-secondary (2)	Upper-secondary (3)	Tertiary (4)
<i>Panel A: ln gross hourly wage rate of natives</i>				
30min * 2002-2006	-0.003 (0.005)	-0.004 (0.009)	-0.005 (0.006)	0.019** (0.009)
30min * 2008-2010	-0.005 (0.006)	-0.003 (0.013)	-0.009 (0.007)	0.029*** (0.010)
30min * 2012-2016	-0.014*** (0.005)	-0.012 (0.017)	-0.016*** (0.005)	0.019* (0.011)
Mean outcome	-0.000	-0.008	0.001	0.001
Sd outcome	0.060	0.074	0.061	0.074
Commuting zones	106	106	106	105
within 30 min	35	35	35	35
N	1166	1166	1166	1144
<i>Panel B: Share of natives in a managerial position</i>				
30min * 2002-2006	0.005* (0.003)	-0.001 (0.004)	0.001 (0.004)	0.029 (0.020)
30min * 2008-2010	0.003 (0.004)	0.007 (0.005)	-0.002 (0.005)	0.023 (0.020)
30min * 2012-2016	0.002 (0.004)	-0.002 (0.004)	-0.001 (0.004)	0.022 (0.026)
Mean outcome	-0.000	-0.001	-0.000	-0.002
Sd outcome	0.023	0.024	0.024	0.093
Commuting zones	106	106	106	105
within 30 min	35	35	35	35
N	1166	1166	1166	1144
<i>Panel C: ln number of natives employed</i>				
30min * 2002-2006	0.008 (0.033)	0.012 (0.066)	-0.018 (0.040)	0.088* (0.053)
30min * 2008-2010	0.013 (0.047)	0.041 (0.088)	-0.000 (0.055)	-0.015 (0.078)
30min * 2012-2016	-0.051 (0.069)	0.033 (0.061)	-0.039 (0.086)	-0.107 (0.111)
Mean outcome	9.553	7.011	9.112	7.952
Sd outcome	1.136	1.058	1.073	1.505
Commuting zones	106	106	106	105
within 30 min	35	35	35	35
N	1166	1166	1166	1144

Source: SESS.

Note: The table shows difference-in-differences estimates using biennial data at the commuting zone level for the period 1996–2016. The sample consists of employees aged 18–40. The dependent variable in Panel A is the mean natural log of gross hourly wage of natives (residualized) in an education category, in Panel B the share of natives holding at least a middle management position (residualized) in an education category, and in Panel C the natural log of number of natives employed in education category. Observations are weighed by the number of native employees in a specific education category in 1996. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 9: Native Labor Market Outcomes by Education and Occupation

	Upper-secondary		Tertiary	
	STEM (1)	Non-STEM (2)	STEM (3)	Non-STEM (4)
<i>Panel A: ln gross hourly wage rate of natives</i>				
30min * 2002-2006	0.003 (0.005)	-0.008 (0.006)	0.019 (0.012)	0.022 (0.021)
30min * 2008-2010	0.004 (0.006)	-0.009 (0.007)	0.012 (0.016)	0.041 (0.026)
Mean outcome	0.001	0.001	0.003	-0.001
Sd outcome	0.052	0.079	0.070	0.089
Commuting zones	106	106	98	100
within 30 min	35	35	33	35
N	848	848	766	791
<i>Panel B: Share of natives in a managerial position</i>				
30min * 2002-2006	0.004 (0.006)	-0.006 (0.005)	-0.020 (0.031)	0.053*** (0.016)
30min * 2008-2010	0.002 (0.007)	-0.010 (0.006)	-0.032 (0.034)	0.032 (0.022)
Mean outcome	-0.000	0.000	-0.007	-0.001
Sd outcome	0.028	0.032	0.130	0.113
Commuting zones	106	106	98	101
within 30 min	35	35	33	35
N	848	848	766	798
<i>Panel C: ln number of natives employed</i>				
30min * 2002-2006	-0.049 (0.048)	0.012 (0.048)	0.047 (0.078)	0.097 (0.083)
30min * 2008-2010	-0.085 (0.055)	0.057 (0.068)	-0.138 (0.090)	0.077 (0.118)
Mean outcome	8.059	8.670	6.726	7.407
Sd outcome	0.908	1.224	1.393	1.598
Commuting zones	106	106	98	101
within 30 min	35	35	33	35
N	848	848	766	798

Source: SESS.

Note: The table shows difference-in-differences estimates using biennial data at the commuting zone level for the period 1996–2010. The sample consists of employees aged 18–40. The dependent variable in Panel A is the mean natural log of gross hourly wage of natives (residualized) in an education-occupation category, in Panel B the share of natives holding at least a middle management position (residualized) in an education-occupation category, and in Panel C the natural log of number of natives employed in education-occupation category. Observations are weighed by the number of upper-secondary educated native employees in 1996 in Columns 1–2 and tertiary educated native employees in 1996 in Columns 3–4. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 10: Native Enrollment Rate at Universities of Applied Sciences by Educational Background

	Outcome: share of native first-year students in birth cohort				
	General	Vocational	Vocational STEM	Vocational non-STEM	Other
	(1)	(2)	(3)	(4)	(5)
30min * 2002-2006	-0.002 (0.002)	0.003 (0.003)	-0.001 (0.002)	0.004* (0.002)	0.002 (0.001)
30min * 2007-2017	-0.003 (0.002)	0.013*** (0.004)	0.003 (0.002)	0.009*** (0.003)	0.001 (0.001)
Mean outcome	0.033	0.106	0.042	0.059	0.004
Sd outcome	0.018	0.040	0.017	0.031	0.005
Commuting zones	106	106	106	106	106
within 30 min	35	35	35	35	35
N	2226	2226	2226	2226	2226

Source: SHIS-studex.

Note: The table shows difference-in-differences estimates using annual data at the commuting zone level for the period 1997–2017. The dependent variable is the share of native first-year students in the birth cohort. Column 1 shows first-year students with a general education (general matura), Column 2 first-year students with a vocational background (vocational or specialized education). In Columns 3 and 4 we split the individuals with a vocational background into STEM and non-STEM. Column 5 shows results for first-year students who cannot be classified as generally or vocationally educated. Observations are weighed by the cohort size in 1997. Standard errors in parentheses are clustered at the commuting zone level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Figures

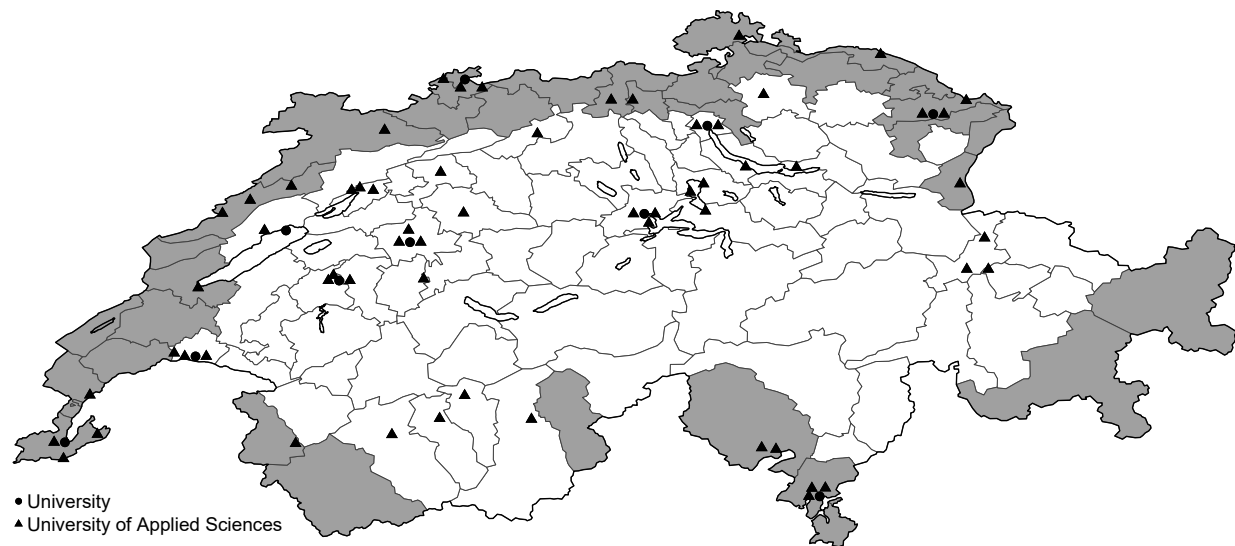


Figure 1: Tertiary Institutions in Affected and Non-Affected Areas in 2017

Source: Swisstopo.

Note: The map shows Switzerland's 106 commuting zones split into affected (grey) and non-affected units (white) and the location of tertiary institutions by institutional type.

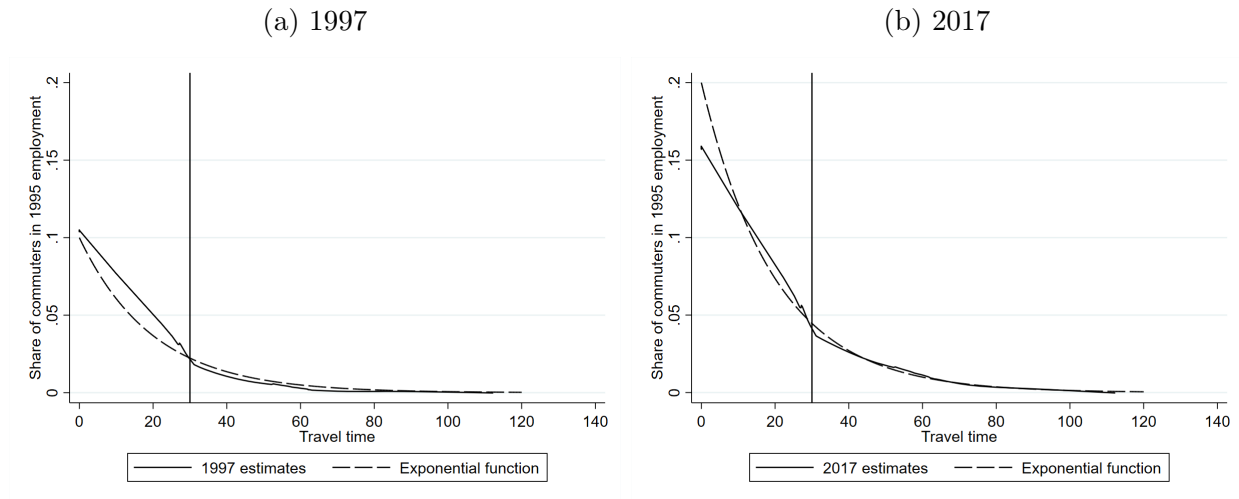


Figure 2: Share of Cross-Border Commuters and Travel Time

Source: FSO.

Note: The figure shows estimates from a locally weighted regression of the share of cross-border commuters in 1997 in Subfigure (a) and 2017 in Subfigure (b) relative to 1995 employment on travel time to the closest Swiss border crossing. The unit of observation is the commuting zone. The dashed line plots the function $\exp(-0.05 \times \text{travel time})$ rescaled by ten in Subfigure (a) and five in Subfigure (b). The vertical line is drawn at 30 minutes travel time.

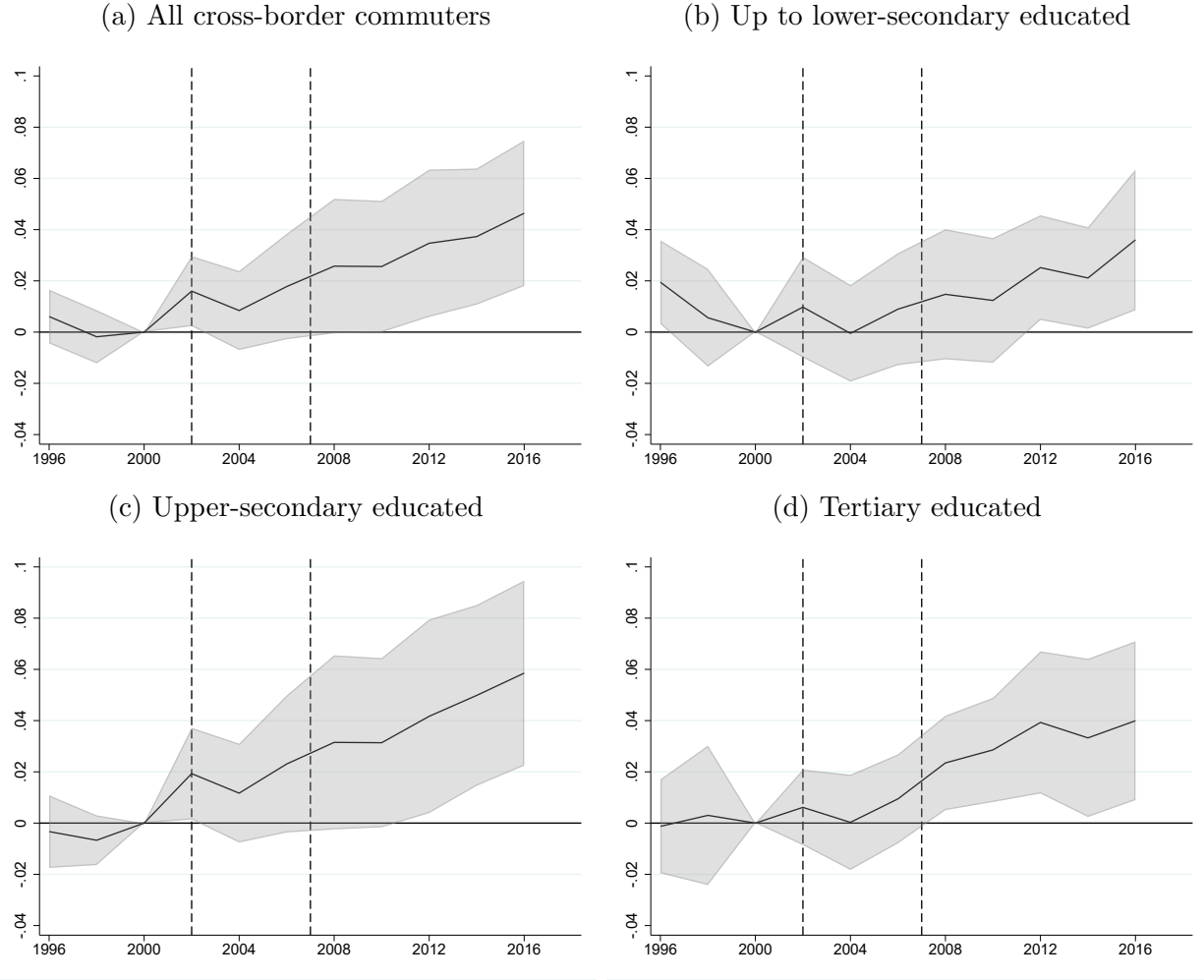


Figure 3: Exposure to Cross-Border Commuters by Educational Level

Source: SESS.

Note: The figure shows difference-in-differences estimates using biennial data at the commuting zone level for the period 1996–2016. The reference year is 2000. The vertical lines indicate the beginning of the transition period (2002) and of the post-reform period (2007). The dependent variable is the share of cross-border commuters in total employment by educational level. Observations are weighed by the number of total employees in 1996. Standard errors are clustered at the commuting zone level; 95% confidence intervals are shown.

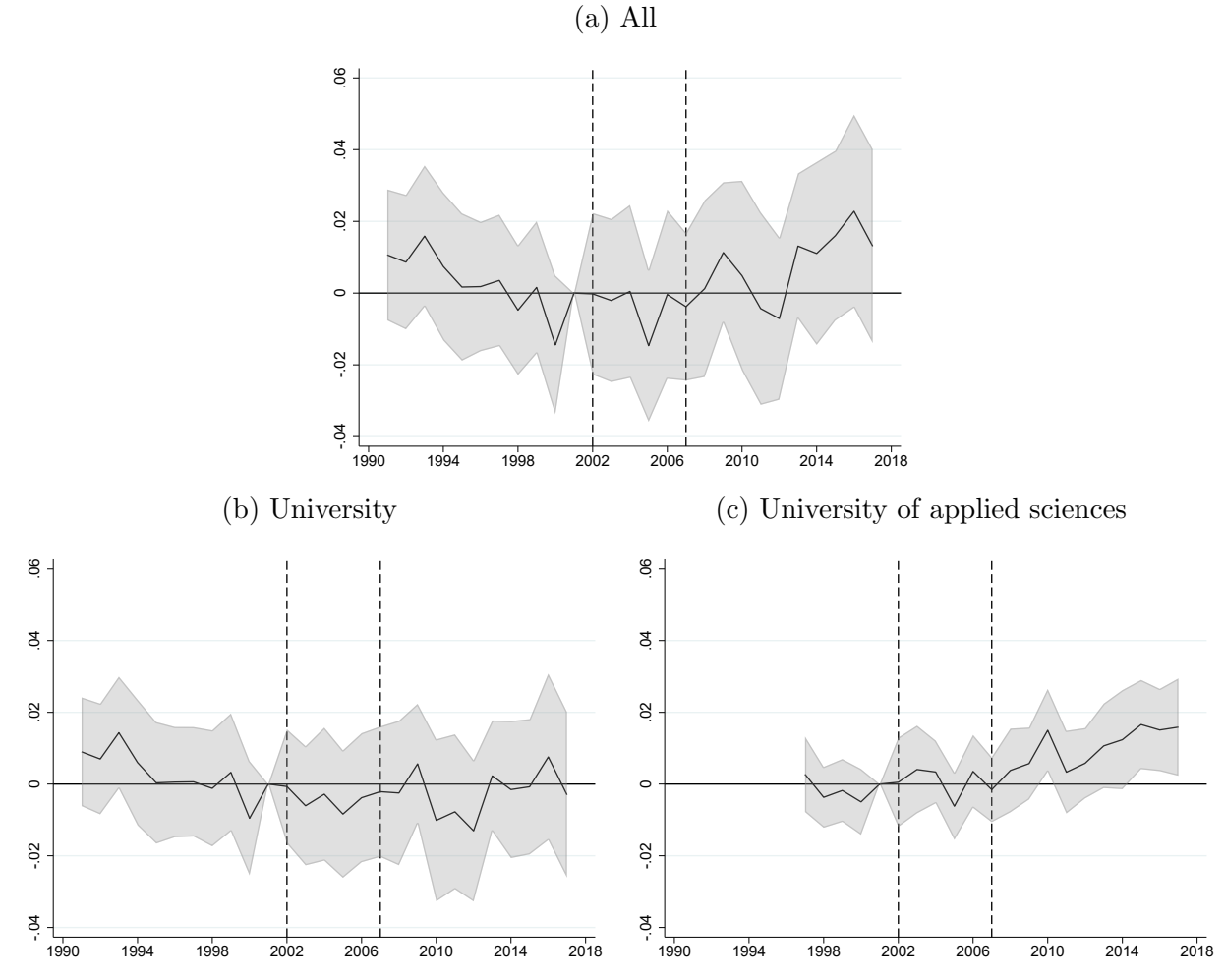


Figure 4: Native Enrollment Rate by Institutional Type

Source: SHIS-studex.

Note: The figure shows difference-in-differences estimates using annual data at the commuting zone level for the period 1991–2017. The reference year is 2001. The vertical lines indicate the beginning of the transition period (2002) and of the post-reform period (2007). The dependent variable is the share of native first-year students in the birth cohort by institutional type. Observations are weighed by the cohort size in 1997. Standard errors are clustered at the commuting zone level; 95% confidence intervals are shown.

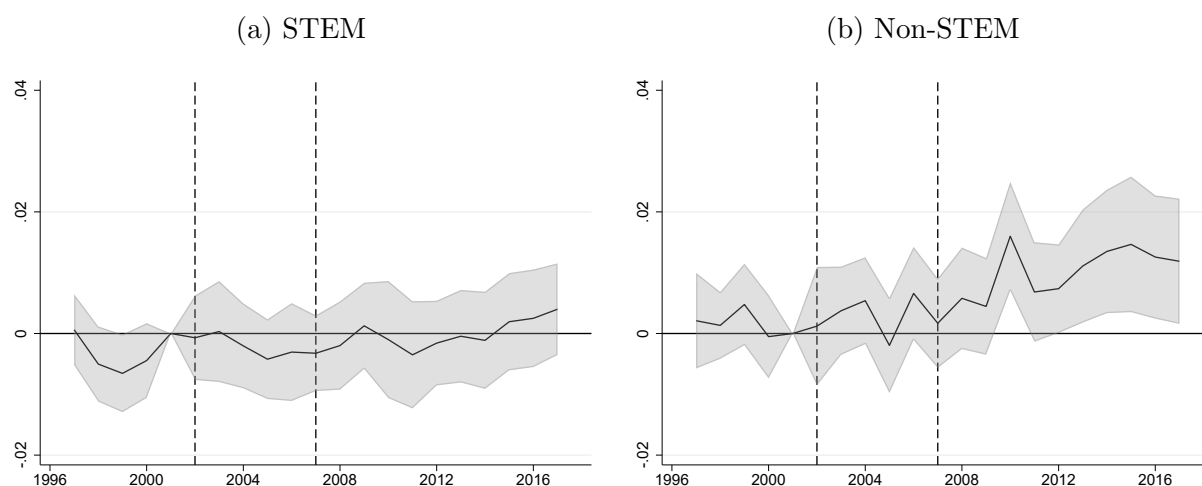


Figure 5: Native Enrollment Rate by Type of Study Field at Universities of Applied Sciences
Source: SHIS-studex.

Note: The figure shows difference-in-differences estimates using annual data at the commuting zone level for the period 1997–2017. The reference year is 2001. The vertical lines indicate the beginning of the transition period (2002) and of the post-reform period (2007). The dependent variable is the share of native first-year students in the birth cohort by study field. Observations are weighed by the cohort size in 1997. Standard errors are clustered at the commuting zone level; 95% confidence intervals are shown.

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